ECONOMIC IMPACT OF AN ALTERNATIVE COMMODITY PRICE SERIES FOR THE MAJOR FARM PROGRAM CROPS

A Thesis

by

LACEY ROSE JENNINGS

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Chair of Committee,	Joe L. Outlaw
Committee Members,	James W. Richardson
	Monte Dozier
Head of Department,	C. Parr Rosson III

August 2018

Major Subject: Agricultural Economics

ABSTRACT

American farmers agree that the current 2014 Farm Bill Title I safety net programs are effective and have worked as they were designed. However, due to steadily declining crop prices and difficult agricultural economic times, there is a growing need for improvement of the timing of Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC) payments. In the current state of the American agricultural economy, it is becoming increasingly more difficult for farmers to cash flow and to obtain operating loans from lenders. For this reason, Congress is working to find a solution in the upcoming 2018 Farm Bill so farmers can be paid sooner than they are under the current farm bill. This research was conducted at the request of the Chief Economist of the House Agricultural Committee, Bart Fischer.

The objective of this study was to evaluate alternative payment timing options by calculating a new marketing year average (MYA) price series for determining PLC and ARC payments. A stochastic simulation model was used to estimate the probability of triggering commodity program payments for the baseline and four alternative formulas for calculating MYA prices. Several outcomes were examined with attention primarily focused on the forecasted 2017 MYA prices for the baseline and alternatives, the 2017 forecasted ARC government payments, and the 2017 forecasted PLC government payments.

Stochastic Efficiency with Respect to a Function (SERF) analysis results indicated that most farmers prefer the Last Twelve First Five (L12F5) alternative because it has the overall highest program payments, but overall farmers are undecided on which alternative price series they prefer. Additionally, the results for the 12-month baseline price series is preferred by taxpayers because it has the lowest amount of government payments. It is important to note that

there is not a single alternative that both producers and taxpayers agree upon, therefore, no assumptions may be drawn at this point and farther analysis is needed.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Joe Outlaw, and my committee members, Dr. James Richardson, and Dr. Monte Dozier for their guidance and support throughout the course of this research.

Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience.

Thank you to my mother and father for their love and encouragement and for always supporting my dreams!

Finally, thank you to my husband for his patience, support and love! You have been here for me every step of the way, and I honestly do not know what I would do without your reassurance and stability.

CONTRIBUTORS AND FUNDING SOURCES

This work was supervised by a thesis committee consisting of Professor Outlaw [advisor] and Professor Richardson of the Department of Agricultural Economics and Doctor Dozier of Agriculture and Natural Resources. The data collected for Chapter 3 was provided by James M. Raulston. All other work for the thesis was completed by the student independently.

There were no outside funding contributions to acknowledge related to the research and compilation of this document.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

The Agricultural Adjustment Act of 1933, the first farm bill, has provided relief for American farmers and ranchers in hard economic times since its inception in 1933. It was created during the Great Depression to provide market stabilization by means of limiting the supply of commodities produced. Today however, the Title I program is "designed to provide specific forms of income assistance without interfering with the market and is compatible with our free trade goals and obligations under the World Trade Organization" ("Farm Bill" par. 5). Since its inception, it has continued to evolve to meet the ever-changing needs of producers. The most recent 2014 Farm Bill was no exception; in it, several changes were adopted.

The most significant change in the 2014 bill was the elimination of direct and counter-cyclical payments (Wallace, Siobhan). This included the Direct Payments (DP), Counter Cyclical Payments (CCP), and Average Crop Revenue Election (ACRE) programs. Direct payments were designed to provide income support that was independent of production or prices (Outlaw et al. 2008, pp 13). The CCP program "provided payments to producers on historical base acres and yields but were triggered by movements in current prices," and the ACRE program made "payments to producers when their revenues fell below benchmark levels" ("Crop Commodity Program" par. 1). In 2014, direct payments, ARCE and CCP, were replaced with two new revenue loss assistance programs, Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC). Under PLC and ARC, producers must incur losses to receive income assistance payouts.

The 2014 Farm Bill has worked well by providing real relief to farmers and ranchers when they need it most. However, there is room for reform in some areas of the upcoming 2018 Farm Bill, specifically, the timing of PLC and ARC payments. Several industry representatives testifying before the Agricultural Committees of the United States Senate and House of Representatives in farm bill hearings mentioned the need to receive safety net payments on a more timely basis. Currently, producer safety net payments are based on the marketing year average (MYA) price for each commodity. The MYA price is calculated as the weighted average using the national monthly prices for the commodity, weighted by monthly marketings, beginning at harvest and ending prior to the next year's harvest. As a result, safety net payments for the current year crop cannot be made until the marketing year ends, roughly 14 months after the crop is harvested. When writing the 2014 Farm Bill, due to political and budgetary considerations, lawmakers had to shift payments under the Title 1 programs until after the subsequent fiscal year, which is after the crop year has concluded (National Association of Wheat Growers, pp 5). The timing decision has made it difficult for producers to obtain annual operating loans.

Each year, to secure operating loans, farmers must prepare a farm plan for their banks showing their farm will generate a positive cash flow with the expected revenue from the crop mix they plan to plant as well as what they expect to pay for inputs, rent, machinery and/or land payments, and living expenses (National Barley Growers Association, pp 2). The Chairman of the National Sorghum Producers Legislative Committee and the Vice President of the National Sorghum Producers board of directors, Dan Atkisson, testified to the House Subcommittee on General Farm Commodities and Risk Management:

> The National Sorghum Producers believes in the need for a strong and reliable Title I safety net that is appropriately balanced and provides assistance when and where it is needed. One very real problem with the current policy that is felt very acutely in times like this has to do with something as simple as the timing of payments and the problem this poses for farmers trying to cash flow. The National Sorghum Producers asks you to consider moving up the timing of Farm Bill assistance, so the support is put in the hands of farmers earlier than a full calendar year following the crop year it is meant to cover. (National Sorghum Producers, pp 5).

However, in recent years, the only way for many farmers to reach a positive cash flow is by including their expected program support payments. Unfortunately, "current federal banking regulations are not allowing banks to include this expected payment because the year-long discovery period for the 2017 average marketing year price does not begin until after harvest and is considered too far in the future and speculative to be included" (National Barley Growers Association, pp 2). If producers are not able to prove that their farm will produce a positive cash flow, and they have no other capital that can be included, they could be denied an operating loan. Without money upfront, many producers could be put out of business.

The consensus among American producers is that the current Title I safety net programs are effective and are working as they were designed. However, due to steadily declining crop prices and difficult agricultural economic times, there is a growing need for improvement to these policies. The inability to include the safety net payments in their annual operating budgets, due to lender concerns, has negatively affected farmers nationwide. As a result, legislators are seeking to find a solution to the Title I payment timing issues rather than a replacement of the entire policy.

Many farm programs have been studied to analyze the effects of replacing current farm programs with a different type of revenue guarantee program. However, there have been no studies completed to analyze the effects of changing the way the price series in the current revenue guarantee program is calculated to move up the timing of safety net payments.

Objectives of this Research

The primary objective of this research is to evaluate alternative payment timing options by calculating a new price for determining PLC and ARC payments. Four price series alternatives will be used to calculate the MYA prices for each covered commodity, each will then be compared against the baseline price series (the current 12-month MYA price). The proposed analysis will be done to determine an alternative price series that will allow producers and lending institutions a method to accurately estimate the commodity program payments from PLC and ARC earlier than the current system.

CHAPTER II

REVIEW OF LITERATURE

PLC and ARC are revenue-based support programs which were implemented by the 2014 Farm Bill. All evidence, from both farmers and lawmakers, shows that the programs have effectively done their job of only providing farmers with support when it is needed. Because ARC and PLC have worked so well, policymakers want to not only work with farmers to keep the current price support programs, but also address their concerns about the timing of program payments to improve the upcoming 2018 Farm Bill. The literature on farm revenue programs is extensive, however, there has been no research conducted analyzing the effects of changing how the price series in the current revenue guarantee program is calculated to move up the timing of safety net payments.

History

2010 through 2014 were years of growth and prosperity in the American agricultural sector. This period was driven by high commodity prices and rising property values, as well as increased amounts of agricultural exports. After the most recent farm bill was passed in 2014, the U.S. agricultural sector's financial outlook has been in a downward spiral. Natural disasters like Hurricanes Maria, Irma and Harvey and low commodity prices across the country, have caused a downturn in the farm economy (Drafting the Next Farm Bill). "Net farm income has dropped nearly 50 percent over the last four years, the largest, four-year percentage drop since the Great Depression" (Drafting the Next Farm Bill).

The Food and Agricultural Policy Research Institute (FAPRI) and the United States Department of Agriculture (USDA) project that market prices for corn, soybeans, barley, and sunflowers will decrease for the next one to two years (FAPRI 2018). All other covered commodities are predicted to either keep the same MYA price or increase slightly (FAPRI 2018). Because commodity prices are predicted to drop even lower than in recent years, producers will rely even more heavily on safety net payments.

ACR-CO and PLC Commodity Programs Design and Operation

The 2014 Farm Bill mandated that farmers make a one-time choice between PLC and ARC that will last the life of the farm bill (2014-2018). Additionally, under ARC, producers must also choose between county-based (ARC-CO) or individual coverage (ARC-IC) options. Because ARC-IC has such a small participation percentage (less than one percent), this research will only discuss ARC-CO. ARC and PLC each make payments based on historical "base" acres and are therefore decoupled from current producer planting choices. Under the current Farm Bill, PLC and ARC both use the twelve-month national MYA prices for calculating program payments. A complete list of commodities covered under ARC and PLC are shown in table 2.1. Commodities which are included in this research include: corn, sorghum, soybeans, peanuts, canola, sunflowers, wheat, barley, oats, dry peas, medium grain (MG) rice, long grain (LG) rice and cotton[1].

[1] Cotton was not included under ARC and PLC in the 2014 Farm Bill, however, under the 2018 Farm Bill it is now ARC and PLC eligible.

Table 2.1 Farm Safety Net Programs

Program	Commodity Coverage	Program Description	Producer Cost
Commodity Programs *(Administered by USDA's Farm Service Agency)*			
Price Loss Coverage (PLC) ***or*** ***Agriculture Risk Coverage (ARC)***	Covered commodities: wheat, corn, grain sorghum, oats, barley, long grain rice, medium grain rice, pulse crops (dry peas, lentils, small chickpeas, and large chickpeas), soybeans, sunflower seed, rapeseed, canola, safflower, flaxseed, mustard seed, crambe, sesame seed, and peanuts.	PLC payments are made if the national farm price of a "covered" crop is below its statutory fixed reference price. PLC payment rate is capped by difference between reference price and MAL loan rate. ARC payments are made if actual revenue is below 86% of a historical five-year moving average revenue guarantee based on national prices and county yields. ARC payments are capped at 10% of the revenue guarantee.	No participation fee.
Marketing Assistance Loans (MAL)	**Loan commodities:** same crops as for PLC/ARC plus upland cotton, extra-long staple cotton, wool, mohair, and honey.	Loans provide interim financing at statutory loan rates. Optional benefits include loan deficiency payments (LDP), marketing loan gains (MLGs), commodity certificate exchanges, or forfeiture.	No participation fee.
CTAP, CGCS, and EAAU	Upland cotton.	Cotton Transition Assistance Payments (CTAP), Cotton Ginning Cost-Share Program (CGCS), and Economic Adjustment Assistance to Users (EAAU).	No participation fee.
Nonrecourse loans, import quotas, and marketing allotments	Refined beet sugar and raw cane sugar.	Minimum price guarantee for processors, limits on domestic sugar sales for human use, and tariff-rate quota protection from imports.	No participation fee. Generally, no net federal cost.
Margin Protection Program (MPP) and Dairy Product Donation Program (DPDP)	Milk.	MPP payments are made if actual two-month average margin (milk price minus feed cost) is below producer-selected threshold. Under DPDP, USDA buys dairy products for donation to low-income persons when margin is low.	$100 fee plus statutorily fixed premium for coverage selected by producer.
Federal Crop Insurance *(Administered by USDA's Risk Management Agency)*			
Crop insurance policies	More than 100 crops, including commodity program crops (see above), specialty crops (fruits, tree nuts, vegetables, nursery crops), pasture, rangeland, forage crops, and livestock margins.	Indemnities triggered when actual yield or revenue falls short of the guarantee set at 50%-85% of expected level (as selected by producer) and established at prices prior to planting. Loss is at field or county level, depending on policy.	Premium depends on producer-selected deductible and other risk factors. Producer pays a portion of premium; no delivery cost.
Stacked Income Protection (STAX)	Upland cotton.	Indemnifies area-wide revenue losses >10% of guarantee, up to deductible (with max of 30%).	Producer pays 20% of premium (80% subsidized).
Supplemental Coverage Option	Program crops enrolled in PLC.	Supplements crop insurance, indemnifies area-wide losses >14% of guarantee up to deductible.	Producer pays 35% of premium (65% subsidized).
Disaster Assistance, Noninsured Crop Disaster Assistance Program, & Emergency Loans *(Administered by USDA's Farm Service Agency)*			
Supplemental Agricultural Disaster Assistance Programs	Beef/dairy cattle, bison, poultry, sheep, swine, horses, other livestock, honeybees, farm-raised fish, and trees/bushes/vines producing an annual crop.	Payment for excess livestock mortality (LIP), grazing losses (LFP), other losses (ELAP), and excess fruit tree/vine mortality (TAP). Disaster designation not required. See notes below for program names.	No participation fee.
Noninsured Crop Disaster Assistance Program (NAP)	Available for crops not currently eligible for crop insurance.	Payments for losses in excess of 50%. Additional coverage is available for purchase.	Participation fee of $250 per crop plus a charge for more coverage.
Emergency Loans (EM)	Crops and livestock (also physical losses to real estate).	Low-interest loans for producers in a disaster county and not eligible for commercial credit. Requires disaster designation.	Producers repay interest and principal in one to seven years (longer for real estate).

Source: CRS reports: R43758 (farm safety net), R43448 and R44914 (commodity programs), R40532 and R43494 (crop insurance), RS21212 (disaster assistance), R44739 (program eligibility and payment limits), and RS20840 and R43817 (WTO rules and limits on domestic support).

Notes: Additional support for dairy via import restrictions and federal milk marketing orders (CRS Report R43465); sugar via a sugar-to-ethanol program (CRS Report R43998). Disaster programs: Livestock Indemnity Payments (LIP); Livestock Forage Disaster Program (LFP); Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP); and Tree Assistance Program (TAP)—see CRS Report R42854.

Randy Schnepf, Coordinator, rschnepf@crs.loc.gov, 7-4277

Source: Reprinted form. Johnson, Renee (2017). *Previewing a 2018 Farm Bill* (CRS Report No. R44784). Retrieved from: www.nationalaglawcenter.org/wp-content/uploads//assets/crs/IF10638.pdf; p. 13.

Agricultural Risk Coverage (ARC-CO)

ARC was designed to be a "shallow-loss" revenue program, meaning, "it addresses the smaller revenue losses typically not covered under the Federal Crop Insurance program (programs that cover the "deep losses" potentially felt by producers)" (O'Donoghue et al. 1). Under ARC-CO, the county benchmark revenue for the crop is defined as the five-year Olympic moving average county yield times the five-year Olympic moving average MYA price or the reference price, whichever is higher (Crop Commodity Programs). The per-acre county revenue guarantee is 86 percent of the county benchmark revenue. Therefore, payments are issued to producers if the actual county revenue falls below the county revenue guarantee. The payment is capped at 10 percent of the county revenue benchmark and is only provided for 85 percent of base acres (Crop Commodity Programs).

ARC-CO Equations:

<u>Benchmark Yields</u> = Prior 5-year Olympic Moving Average County Yield (dropping the high and low years and averaging the remaining 3 years)

<u>Benchmark Prices</u> = Prior 5-year National Olympic Moving Average MYA Price (dropping the high and low years and averaging the remaining 3 years)

*<u>County Benchmark Revenue</u> = Prior 5-year National Olympic Moving Average MYA Price * Prior 5-year Olympic Moving Average County Yield (dropping the high and low years and averaging the remaining 3 years)*

*<u>Actual County Revenue</u> = Actual Average County Yield * Max (National MYA Price or Reference Price)*

*<u>Guaranteed Revenue</u> = Benchmark Revenue * 0.86*

*<u>Max Payment</u> = Benchmark Revenue * 0.10*

ARC Payment per acre = *Min (Guarantee Revenue - Actual Revenue)*

Final Estimated ARC Payment = *ARC Payment per acre * Base Acres * 0.85*

Note all equations are calculated on a commodity-by-commodity basis

Price Loss Coverage (PLC)

PLC was designed to provide support for farmers to mitigate losses from low commodity prices. The 2014 Farm Bill established a reference price for each covered commodity, which was set to reflect the cost of production[2]. The effective price for the specific covered commodity is the higher of either the MYA price or the national average loan rate. PLC payments are issued when the effective price of a covered commodity is less than the reference price for that commodity (ARC/PLC Program). The difference between the two is known as the payment rate. Payments are calculated by multiplying the payment rate by the commodity base acres, the producer's historical payment yield and 85 percent of the planted acres.

PLC Equations:

Effective Price = Max (Loan Rate or MYA price)

Payment Rate = Reference Price – Effective Price

*PLC Payment = Payment Rate * Base Acres * PLC Yield (per acre) * 0.85*

Note all equations are calculated on a commodity-by-commodity basis

[2] Reference prices are fixed for the life of the farm bill, 2014-2018.

The U.S. fiscal year (FY) is a twelve-month accounting cycle, beginning October 1 and ending September 30 of each year (Glossary). Spending that occurs in 2016 and 2017 (FY17), does not show up on the federal government's accounting until 2018 (figure 2.1). National MYA prices used in ARC and PLC calculations, are published by the USDA at the end of each commodity crop year (table 2.2). Because the price component of both programs is constructed using MYA crop prices, program payments are issued after MYA prices are determined and after October 1 of the following year (Shurley and Rabinowitz). David Schemm attests to this problem by saying "seed and fertilizer bills don't wait until a year after the crop is harvested before they come due" (National Association of Wheat Growers).

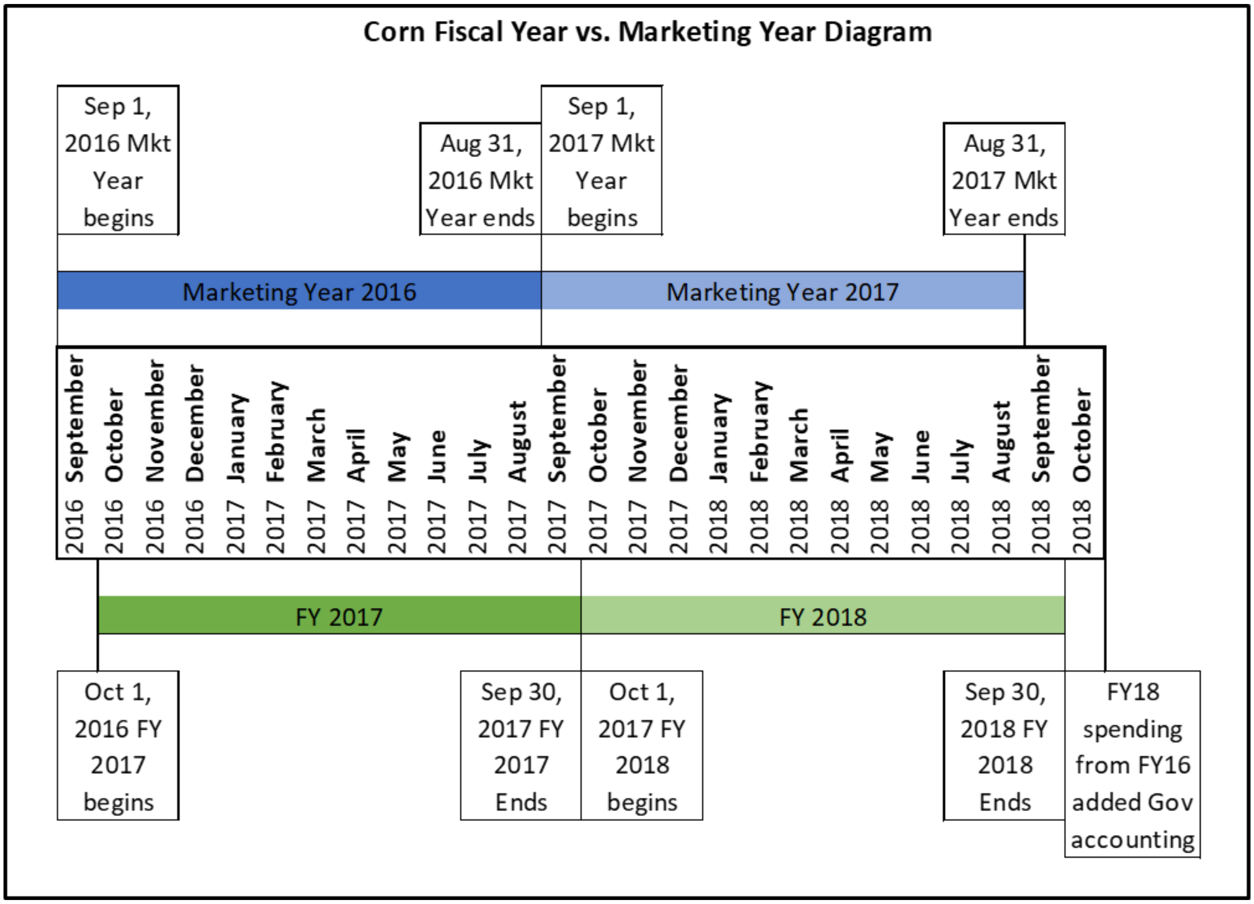

Figure 2.1. Corn Fiscal Year vs Marketing Year Diagram

Table 2.2 U.S. Average Field Crop Marketing Years, Planting Seasons & Payment Months for Covered Commodities

Crop	Planting Month	Beg	End	Payment Month
Corn	April-May	1-Sep	31-Aug	Oct-18
Wheat	March-May	1-Jun	31-May	Oct-18
Barley	April-May	1-Jun	31-May	Oct-18
Oats	April-May	1-Jun	31-May	Oct-18
Sorghum	April-June	1-Sep	31-Aug	Oct-18
Soybeans	May-June	1-Sep	31-Aug	Oct-18
Peas	mid-March-mid-April	1-Jul	30-Jun	Oct-18
Sunflowers	May-June	1-Sep	31-Aug	Nov-18
Canola	Aug-Sep	1-Jul	30-Jun	Dec-18
Peanuts	April-May	1-Aug	31-Jul	Oct-18
All Rice (LG & MG)	April-May	1-Aug	31-Jul	Nov-18

Source: United States; Department of Agriculture; Farm Service Agency; *Understanding ARC/PLC;* 4 Oct. 2016.

Commodity price declines in recent years have led to higher debt-to-asset ratios for most producers (figure 2.2). The ability for producers to obtain operating loans in recent years has been challenging. A Kansas State University agricultural economics professor, Art Barnaby, advised, "farmers could better work with banks on operating loans if USDA would release county yields for ARC earlier in the year. Bankers would not know the exact amount of any ARC payment, but given the weighted average of the MYA price, a banker and farmer would have a better ballpark figure to help evaluate operating loans" (Final Market-Year Prices).

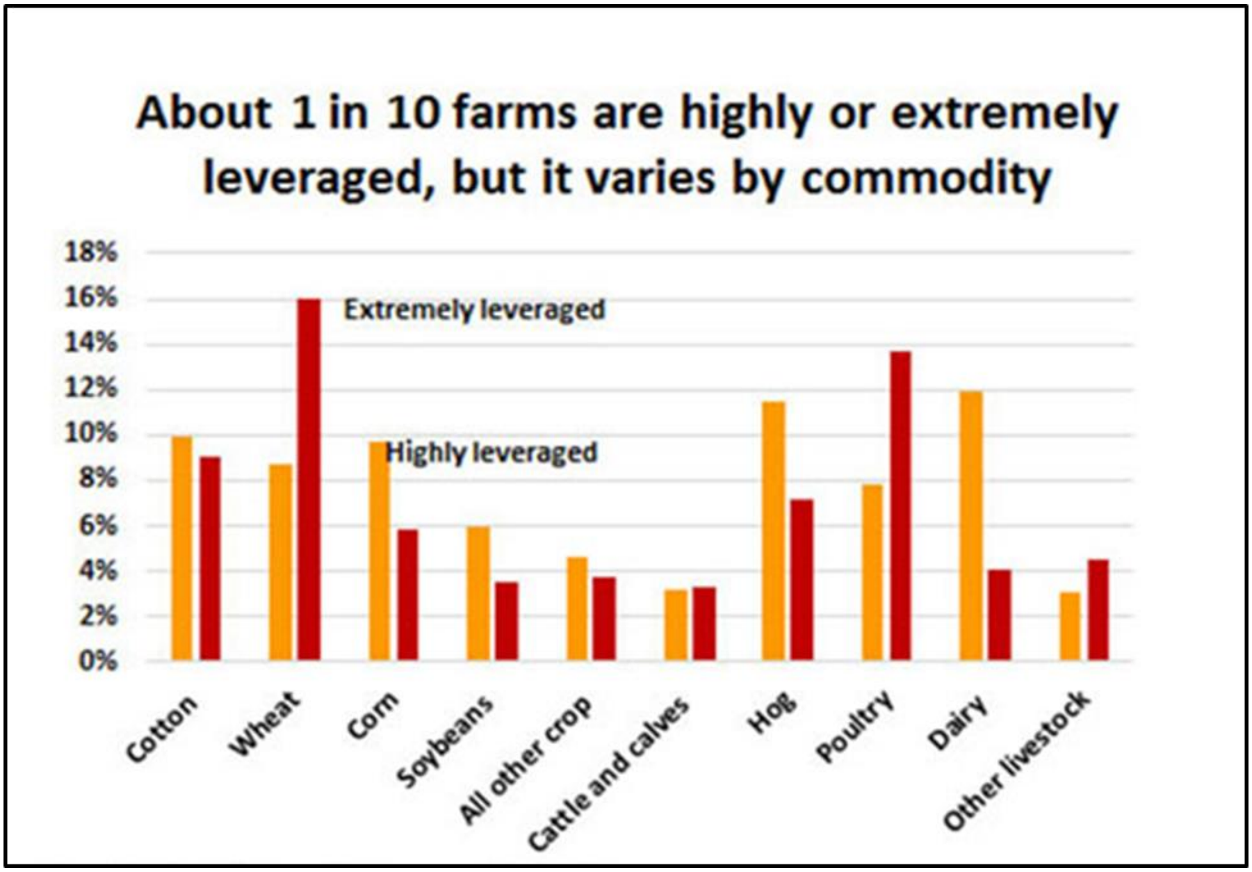

Figure 2.2. Producer Debt Percentage by Commodity. Reprinted form. "National Association of Wheat Growers the Next Farm Bill: Commodity Policy, Part 1." 2017, p. 3.

“ARC revenue benchmarks are based on moving averages of prices and yields and will therefore fluctuate over time. This contrasts with the fixed reference prices used to calculate support for the PLC program” (Crop Commodity Programs). ARC protects producers against recent drops in market prices. However, a problem arises if MYA prices continue to decline for multiple years. The low prices begin to factor into the Olympic moving average, causing the revenue guarantee to fall.

In 2019, producers will once again have to elect between the “certainty of fixed reference prices (PLC) and the flexibility of annually adjusted revenue coverage (ARC)” (Crop Commodity Programs). Declining MYA prices over the last four years have eroded ARC-CO revenue protection. As crop prices are expected to continue to decline in the coming years, it is important that payments for each crop remain set at an adequate level. Simply stated, reference prices for each crop should be analyzed to determine if adjustments are needed, based on future predicted crop prices, to ensure appropriate levels are set for the upcoming 2018 Farm Bill.

Numerous revenue guarantee farm programs have been analyzed using stochastic simulation. However, there have been no studies completed to analyze the effects of changing the way the MYA price series in the current revenue guarantee program are calculated to move up the timing of safety net payments.

Literature on Stochastic Simulation

As previously stated in Chapter I, this research seeks to determine an alternative MYA price series capable of estimating ARC and PLC payments earlier than the current system. To do this, four alternative price series will be analyzed and compared against the baseline price series. To accurately replicate real world situations into predictions, risk must be included using stochastic (Monte Carlo) simulation. In farm policy analysis, the decision maker, in this case, policymakers and producers, needs to have the best information to be able to make informed decisions. “Monte Carlo simulation continues to be the preferred tool for stress testing a business under risk” (Richardson 2008).

An empirical distribution is a useful simulation tool commonly used when there is a limited amount of historical data. Empirical distributions are non-parametric, meaning there is no set form and the frequencies in the historical data shape the distribution. A paper written by Richardson, Gray, and Klose (2000), outline the procedure for including multivariate empirically distributed variables in a simulation model. Since the publishing of this paper, the multivariate empirical (MVEMP) has become a widely accepted simulation method.

Knapek, (2013) used a MVEMP simulation model to examine the interactions between current farm programs (Average Crop Revenue Election (ACRE) and Supplemental Revenue Assistance (SURE), and crop insurance) and new policy changes (drafts of ARC and PLC submitted by the House and Senate) for four representative farms with multiple crops. It was the first of its kind to study all parts of the farm safety net, at one time, or in any combination for modified representative farms. The House and Senate ARC and PLC proposals discussed by Knapek (2013) used the “first five-month marketing year price,” to calculate program payments. The research was conducted to identify any commodity or regional differences in representative farms and to capture the true risks faced by farmers all over the country.

Similarly, Higgins, et al. (2007) used a stochastic simulation model to analyze the farm level economic impacts associated with implementing a new revenue-based farm safety net program for the 2007 Farm Bill. Thirteen different representative crop farms, maintained by the

Agricultural and Food Policy Center (AFPC), were simulated to determine the magnitude and frequency of government payments for each farm policy.

The research using stochastic simulation in agriculture policy is a great starting point, however, the existing literature could be expanded to include adjusting the current revenue guarantee program calculation to be more efficient. Future economic implications of the potential gain to American farmers has not been extensively analyzed. However, the ability for farmers to accurately predict payments in a timely manner to include them when cash flowing would have many potential advantages. This is a first of its kind attempt to analyze alternative MYA price series calculations, and the effects on government payments and producer welfare by moving up timing of program payments.

CHAPTER III

METHODOLOGY AND ASSUMPTIONS

Monte-Carlo (stochastic) simulation is the preferred method for ranking risky alternatives and is a common method used in farm policy analysis. In a farm-level risk assessment and policy analysis, Richardson, Klose, and Gray (2000) outline using a MVEMP simulation model to include crop price and yield risk into simulated outcomes. “Agricultural issues are particularly suitable for analysis with Monte Carlo simulation because of the strong influence of weather and price risks on agriculture” (Richardson 2013). Ignoring risk in a farm policy model leads to inaccurate point estimate forecasts of the stochastic input variables being estimated. Stochastic simulation incorporates these unknown risk factors into the simulated key output variables (KOV’s), producing an accurate range of forecasted possible outcomes.

Stochastic Simulation

The stochastic simulation model created for this analysis was designed using SIMETAR©, a Microsoft Excel add-inn. This research seeks to analyze alternative payment timing options for calculating a new price to determine PLC and ARC-CO payments. Four alternative MYA price series will be calculated and compared to the baseline price series for each covered commodity previously mentioned in Chapter II. Price and production risk will be included by using a multivariate empirical model (MVEMP) probability distribution to simulate these two stochastic variables. Random variables will be simulated 500 times to estimate probability distributions for KOV’s and allow for a robust evaluation of the alternative payment timing options and the impact on ARC and PLC payments.

Stochastic Variables

"Stochastic variables are the variables the decision maker cannot forecast with accuracy" (Richardson 2013). Crop prices and production are the stochastic variables in the model. Both price and production are stochastic because they are determined by exogenous variables such as market conditions and weather and are, therefore, unable to be controlled by farmers and policy makers. Risk for a farm policy analysis is information that is beyond the producers control (Richardson, et al. 2008.). Stochastic prices and production are used to calculate many equations in the model, such as MYA prices and program costs, thus making those equations stochastic as well. Historical data[3], years 2003 through 2016, were collected from the United States Department of Agriculture's National Agriculture Statistics Service (USDA NASS) and used to calculate alternative MYA prices for each program crop (2017). The projected mean annual price taken from the Food and Agricultural Policy Research Institute's (FAPRI) 2017 January Baseline was used to simulate the stochastic 2017 base and alternative price series' data. Alternative scenarios were defined and simulated using different combinations of monthly prices and weights to calculate MYA prices. Each was evaluated based on the probability of triggering commodity program payments.

Baseline and Alternatives

As previously stated in Chapter II, the current Farm Bill uses a twelve-month formula to calculate MYA prices for crops covered under PLC and ARC. Although the current method has

[3] Historical data obtained from NASS includes monthly prices and weights, annual total crop production, and annual crop yields.

worked well throughout the life of the 2014 Farm Bill, improvements to the timing of farm program payments were analyzed in preparation of the upcoming farm bill. To determine the effects of the alternative price series' formulas on farm program payment timing, the current twelve-month MYA formula was used as the basis for comparison in the model, for years 2003 through 2017. Four alternative price series' for calculating MYA prices were suggested by the Chief Economist of the House Committee on Agriculture, Bart Fischer.

For each scenario, calculations were homogeneous for all crops. There is only differentiation between crops with different marketing years (table 3.1)[4]. Meaning, prices and weights[5] are the same for each month, but the weights are adjusted to a sum value of 100.

[4] Table 3.1 includes all covered commodities previously mentioned, including cotton which was not previously eligible for ARC or PLC.

[5] A marketing weight is the proportion of the marketing year's crop that is sold in each month.

Table 3.1 U.S. 2012/2013-2017/18 Marketing Year Average (MYA) Prices, MYA Price Publishing Dates and Units of Measurement for Covered Commodities

Commodity	Marketing Year	Publishing Dates for the Final 2017/18 MYA Prices	Unit	Final 2012/13 MYA Price	Final 2013/14 MYA Price	Final 2014/15 MYA Price	Final 2015/16 MYA Price	Final 2016/17 MYA Price	Projected 2017/18 MYA Price	
Wheat	Jun. 1-May 31	June 28, 2018	Bushel	$7.77	$6.87	$5.99	$4.89	$3.89	$4.65	P
Barley	Jun. 1-May 31	June 28, 2018	Bushel	$6.43	$6.06	$5.30	$5.52	$4.96	$4.45	P
Oats	Jun. 1-May 31	June 28, 2018	Bushel	$3.89	$3.75	$3.21	$2.12	$2.06	$2.65	P
Peanuts	Aug. 1-Jul. 31	August 29, 2018	Pound	$0.3010	$0.2490	$0.2200	$0.1930	$0.1970	$0.2150	P
Corn	Sep. 1-Aug. 31	September 27, 2018	Bushel	$6.89	$4.46	$3.70	$3.61	$3.36	$3.35	P
Grain Sorghum	Sep. 1-Aug. 31	September 27, 2018	Bushel	$6.33	$4.28	$4.03	$3.31	$2.79	$3.15	P
Soybeans	Sep. 1-Aug. 31	September 27, 2018	Bushel	$14.40	$13.00	$10.10	$8.95	$9.47	$9.30	P
Dry Peas	Jul. 1-Jun. 30	September 27, 2018	Pound	$0.1570	$0.1460	$0.1200	$0.1280	$0.1100	$0.1190	P
Sunflower Seed	Sep. 1-Aug. 31	November 29, 2018	Pound	$0.2540	$0.2140	$0.2170	$0.1960	$0.1740	$0.1750	P
Cotton	Aug. 1-Jul. 31	October 30, 2018	Bushel	-	-	-	-	-	-	
Canola	Jul. 1-Jun. 30	September 27, 2018	Pound	$0.2650	$0.2060	$0.1690	$0.1560	$0.1660	$0.1750	P
Rice (long grain)	Aug. 1-Jul. 31	October 30, 2018	Pound	$0.1450	$0.1540	$0.1190	$0.1110	$0.0964	$0.1170	P
Rice (med/short grain) 2/	Aug. 1-Jul. 31	October 30, 2018	Pound	$0.1470	$0.1570	$0.1440	$0.1120	$0.1010	$0.1190	P
Rice (temperate japonica)	Oct. 1-Sep. 30	January 2019	Pound	$0.1840	$0.2070	$0.2160	$0.1810	$0.1410	$0.1600	P

MYA Price=national average price received by producers during the 12-month marketing year.

1/ Final MYA prices--Source: National Agricultural Statistics Service (NASS), Agricultural Prices on the publishing dates. P=Projected MYA prices--Source: USDA's World Agricultural Supply and Demand Estimates report or Interagency Commodity Estimates Committee Minutes. MYA price projections are the mid-point of the price forecast range, when applicable.

2/ Medium/short grain excludes temperate japonica rice.

Source: Reprinted form. United States; Department of Agriculture; Farm Service Agency; *ARC/PLC Program Data;* 8 Mar. 2018; Table 1.

September-August Marketing Year

For the commodities of corn, soybeans, sorghum and sunflowers, the marketing year begins in September and ends in August (table 3.1), and therefore, they share the same calculations for MYA price. The baseline MYA price is computed by taking the sum of the twelve weighted monthly percentages sold (September through August). The equations that form the MYA calculation are:

1. <u>Monthly Percentage of Total Crop Sold</u>= ((monthly average price * monthly weight sold) * 100)
2. <u>Average Prices Received</u>= sum of all monthly percentages of total crop sold

Four alternative payment timing scenarios for calculating MYA prices are evaluated to calculate PLC and ARC payments. Alternative one uses the first five (F5) monthly marketing values of each marketing year to calculate the MYA prices. Alternative two is calculated using the last seven months of the current year and the first five months of the upcoming year (L7F5). Alternative three uses monthly marketings beginning in January of the current marketing year and continues through the next entire crop year (LJTF12). Lastly, alternative four uses the last twelve months of the current year and the first five months of the next year (L12F5) (totaling 17 months). Each scenario is then compared to the baseline on a commodity by commodity basis.

The first alternative formula uses only the first five monthly marketing values (September-January) of each marketing year to calculate the MYA prices. The following steps are used to calculate the MYA price for F5.

1. Monthly marketings[6] are simulated for each of the five months using the FAPRI 2017 forecasted mean and a stochastic forecast of the seasonal index of prices for the crop.
2. Weighted monthly percentages are found by dividing the monthly marketing in month one (September) by the total of the first five monthly marketings (September-January). Stochastic monthly sales are simulated using FAPRI 2017 forecasts of production and a stochastic fractional index of monthly marketings for the crop.
3. Weighted monthly prices are simulated by multiplying the stochastic marketing weights by their corresponding average monthly price indices and stochastic annual price.
4. The weighted monthly prices (September-January) are summed to get the 'first five-month' MYA prices

The second alternative is calculated using the last seven months of the current year and the first five months of the next marketing year (February-August, September-January). The third alternative, uses monthly marketings beginning in January of the previous marketing year, continuing through the next entire marketing year (January-August, September-August). For corn, sorghum, soybeans and sunflowers, there are a total of twenty marketing months included

[6] Monthly marketings are the total physical number of bushels, pounds, or hundred weight (CWT) sold in each month. Each is calculated by multiplying the annual crop production by the monthly weight and dividing by 100. Monthly marketings are computed as the first step in each alternative price series.

(between January and September, there are eight months, plus the next twelve months, equaling 20). This number differs for each crop depending on what month the crop marketing year begins. Alternative four (L12F5) uses the last twelve months of the current year and the first five months of the next year (totaling 17 months).

August-July Marketing Year

Peanuts, cotton, long grain (LG) and medium grain (MG) rice share a marketing year that begins in August and ends in July, as such, the calculations for the MYA price are the same. The baseline MYA price is computed by taking the sum of the twelve weighted monthly percentages sold (August through July). The first alternative formula uses only the first five monthly marketing values (August-December) of each marketing year to calculate the MYA prices. The second alternative is calculated using the last seven months of the current year and the first five months of the upcoming year (January-July, August-December). The third alternative uses monthly marketings beginning in January of the previous marketing year and continues through the next entire marketing year (January-August, September-August). For peanuts, cotton, LG, MG trice, there are a total of nineteen marketing months included (between January and July, there are seven months, plus the next twelve months, equaling 19). Alternative four (L12F5) uses the last twelve months of the current year and the first five months of the next year (totaling 17 months).

July-June Marketing Year

The marketing year for both Canola and dry peas begins in July and ends in June; therefore, the calculations for MYA price are the same as well. The baseline MYA price is computed by taking the sum of the twelve weighted monthly percentages sold (July through June). The formula for F5, uses only the first five monthly marketing values (July-November) of each marketing year to calculate the MYA prices. The second alternative was calculated using the last seven months of the current year and the first five months of the upcoming year (December-June, July-November). The third alternative uses monthly marketings beginning in January of the previous marketing year and continues through the next entire marketing year (January-June, July-June). For canola and dry peas, there are eighteen marketing months included (there are six months between January and June, plus the next twelve months, equaling 18). Alternative four (L12F5) uses the last twelve months of the current year and the first five months of the next year (totaling 17 months).

June-May Marketing Year

Wheat, barley and oats each have marketing years beginning in June and ending in May, because of this, their calculations for MYA price are the same. The baseline MYA price was computed by taking the sum of the twelve weighted monthly percentages sold (June through May). The first alternative formula uses only the first five monthly marketing values (June-October) of each marketing year to calculate the MYA prices. The second alternative was calculated using the last seven months of the current year and the first five months of the upcoming year (November-May, June-October). The third alternative uses monthly marketings beginning in January of the previous marketing year and continues through the next entire marketing year (January-May, June-May). For wheat, barley and oats, there are a total of seventeen marketing months included (between January and May, there are five months, plus the next twelve months, equaling 17).

Alternative four (L12F5) uses the last twelve months of the current year and the first five months of the next year (totaling 17 months).

Simulating MYA Prices

To determine the probability of triggering government safety net payments, risk must be included in the calculation. As such, a stochastic simulation model is used to sample the stochastic variables probability distribution functions (PDF's)[7]. Once the variables were simulated, validation and verification tests were performed on the results. Results exposed significant seasonal variability and correlation among the simulated historical variables.

To accurately estimate the parameters for the PDF's, the seasonal variability in the data must first be removed to isolate the actual risk for the stochastic variables. The seasonal pattern in the prices and production was removed using a seasonal price index and a fractional contribution index to simulate the stochastic variables. Therefore, a seasonal price index (SPI) and a fractional contribution index (FCI) were used to forecast stochastic 2017 monthly prices and weights for marketing each crop. Stochastic monthly prices and weights were simulated using the January 2018 FAPRI baseline[8] prices and production as the average and a stochastic index for each crop. Additional information on SPI and FCI calculations can be found in Appendix A.

Stochastic MYA prices for the base and each alternative price series were simulated using the stochastic monthly prices and their associated weights. In other words, under F5, the

---

[7] A PDF is a "schedule of probabilities associated with alternative values of a random variable, for example a histogram or bell-shaped curve" (Richardson, 2013).
[8] FAPRI 2018 predicted baseline annual prices and production were used to provide more accurate forecasts.

stochastic monthly corn prices for September through January 2017 became the stochastic MYA prices for 2017.

Prices and production are inversely related, therefore, if the model is correct, they should be negatively correlated. If the negative correlation between prices and yields is ignored, the means will be biased, and the risk will be overstated for the key output variables (KOV's) (Richardson 2013). To insure the correlation is appropriately incorporated, a SIMETAR© function, multivariate empirical model (MVEMP) as percent deviations from trend was used. Because there is an insufficient amount of historical data available, a non-parametric empirical distribution was used to estimate the parameters. An empirical distribution has a minimum and maximum which allows the data to determine the shape of the distribution. Using percent deviations from trend when simulating stochastic variables, ensures that the result will be coefficient of variation stationary.

Stochastic 2017 MYA prices and production for each price series (forecasted means) and a trend forecasted yield were simulated using the MVEMP function. To accurately determine the probability of triggering program payments, each random monthly price was simulated using its historical risk and the underlying uniform standard deviate (USD's) was the same for each scenario. As a result, the base and each alternative price series were compared without bias caused by using different USD's for each scenario. The random variables were simulated and produced separate probability distributions for each of the 2017 monthly prices and weights. The model simulated the forecasted values, for 500 possible iterations or possible outcomes and summary statistics were calculated.

Validation and Verification

After the variables were simulated, the model was verified for accuracy and correctness by checking equations and ensuring all variables were used appropriately. A series of statistical validation tests were run on the simulated variables to ensure they are statistically equal to their historical data. "Statistical testing of the simulated distributions is required to determine whether the stochastic variables in the model are statistically different from the associated historical data" (Richardson, J. et al. 2008). First, a Student's t-test was performed to test the null hypothesis that the forecasted means are statistically equal to the simulated means. An F test was also run on each variable to test the variance of the simulated data verses the historical data.

The model used a SPI and a FCI to simulate the forecasted 2017 means instead of using means from historical data. As a result, a test parameters validation test was used to test if the simulated means are statistically equal to the forecasted assumed means. Similarly, a Student's t-test was used to test the MVEMP model for correlation at the 99^{th} percent level; this was done using the historical correlation matrix used to calculate the CUSD's, and the simulated variables to determine if their correlation coefficients are statistically equivalent. Results of the validation tests conclude that the MVEMP model is correct and the simulated variables accurately replicate the relationships represented in the original forecasted data series.

Stochastic MYA prices were used in the PLC and ARC-CO payment formulas to simulate total U.S. producer payments by crop. The purpose of the simulation is to estimate the probability distribution of payments for the base and alternative formulas for calculating MYA prices. The summary statistics for the probability distributions were compared by crop to determine the effects of each alternative formula on PLC and ARC payments.

Key Output Variables (KOVs)

1. Forecasted 2017 MYA prices for the baseline and alternatives
2. 2017 forecasted ARC government payments
3. 2017 forecasted PLC government payments

The variables were simulated, generating the probability distributions for each of the KOV's. Summary statistics for each of the KOV's were calculated and used to create ARC and PLC stochastic efficiency with respect to a function (SERF) graphs. SERF analysis was used to determine the decision makers' rankings of risky alternatives.

CHAPTER IV

RESULTS AND ANALYSIS

The analysis was conducted for thirteen covered commodities described in Chapters II and III, for the current 12 month marketing year baseline and four alternative MYA price scenarios: First Five (F5), Last Seven First Five (L7F5), the Start Last January to First 12 (LJTF12) and the Last Twelve First 5 (L12F5). Stochastic 2017 MYA prices and stochastic 2017 government payments for both ARC and PLC were simulated through a total of 500 iterations, for all thirteen crops.

This section uses means, maximums and minimums, as well as stochastic efficiency with respect to a function (SERF) charts to explain results and their effects on program payment timing and preferences. ARC and PLC payments were determined using the current 2014 Farm Bill baseline calculation method, and for each of the four alternative MYA price series formulas. A SERF analysis of the program payments of each price series scenario was presented to compare and rank taxpayer and producer preferences. An annual program payment comparison table was used to summarize the differences between estimated ARC and PLC payments under the baseline and each price series.

Stochastic 2017 MYA Price Results

The base and each alternative price series' stochastic 2017 MYA prices were simulated together to forecast the 2017 MYA prices. As previously discussed, the purpose of this analysis is to find the alternative that best replicates the baseline to calculate payments. Therefore, the same reference prices are assumed for each price series, to ensure that the only difference between the projected ARC and PLC payments are the formulas to calculate the MYA prices. Table 4.1 is a side-by-side comparison of the base and the four alternative calculations estimated using the 2017 MYA prices. The mean prices in table 4.1 are the average annual MYA crop prices for each alternative price series. The analysis shows the MYA prices, under each alternative price series.

	Corn ($/BU) Base 2017	Corn ($/BU) F5	Corn ($/BU) L7F5	Corn ($/BU) LJTF12	Corn ($/BU) L12F5
Mean	3.2189	3.0633	3.2410	3.2809	3.2584
StDev	0.9472	0.8525	0.8597	0.8511	0.7719
CV	29.4260	27.8305	26.5245	25.9424	23.6894
Min	2.0477	1.9570	2.1317	2.1639	2.2134
Max	5.1584	5.0259	5.0505	5.0755	4.8716

	Soybeans ($/BU) Base 2017	Soybeans ($/BU) F5	Soybeans ($/BU) L7F5	Soybeans ($/BU) LJTF12	Soybeans ($/BU) L12F5
Mean	9.2336	8.7053	8.9676	9.3109	9.2258
StDev	1.8562	1.6779	1.6240	1.6956	1.5328
CV	20.1022	19.2744	18.1099	18.2108	16.6141
Min	6.6825	6.5532	6.5396	7.0192	6.8549
Max	12.5882	12.0054	11.8567	12.2147	11.6468

	Sorghum ($/BU) Base 2017	Sorghum ($/BU) F5	Sorghum ($/BU) L7F5	Sorghum ($/BU) LJTF12	Sorghum ($/BU) L12F5
Mean	3.0394	2.9141	3.2080	3.8446	2.5096
StDev	0.9294	0.9505	0.9829	1.0271	0.6575
CV	30.5799	32.6186	30.6395	26.7158	26.1982
Min	1.8134	1.6544	1.6925	2.4686	1.5886
Max	4.7392	4.9644	5.1603	5.8209	3.8948

	Wheat ($/BU) Base 2017	Wheat ($/BU) F5	Wheat ($/BU) L7F5	Wheat ($/BU) LJTF12	Wheat ($/BU) L12F5
Mean	4.6803	4.4988	4.2459	4.4158	4.0254
StDev	1.1069	1.0989	0.9905	0.9947	0.8089
CV	23.6504	24.4268	23.3280	22.5248	20.0941
Min	2.8515	2.6658	2.6041	2.7922	2.6402
Max	6.3199	6.6815	6.4651	6.1199	5.5708

	Peanuts($/LB) Base 2017	Peanuts($/LB) F5	Peanuts($/LB) L7F5	Peanuts($/LB) LJTF12	Peanuts($/LB) L12F5
Mean	0.2297	0.2261	0.2115	0.2187	0.2069
StDev	0.0381	0.0412	0.0332	0.0320	0.0312
CV	16.5928	18.2147	15.7132	14.6355	15.0844
Min	0.1838	0.1767	0.1631	0.1716	0.1567
Max	0.3233	0.3403	0.3128	0.2939	0.2917

	Long Grain Rice ($/LB) Base 201	Long Grain Rice ($/LB) F5	Long Grain Rice ($/LB) L7F5	Long Grain Rice ($/LB) LJTF12	Long Grain Rice ($/LB) L12F5
Mean	0.1153	0.1181	0.1033	0.1059	0.1020
StDev	0.0149	0.0158	0.0117	0.0116	0.0110
CV	12.9467	13.3574	11.2791	10.9236	10.8270
Min	0.0958	0.0937	0.0899	0.0919	0.0895
Max	0.1444	0.1454	0.1223	0.1287	0.1179

	Medium Grain Rice ($/LB) Base	Medium Grain Rice ($/LB) F5	Medium Grain Rice ($/LB) L7F5	Medium Grain Rice ($/LB) LJTF12	Medium Grain Rice ($/LB) L12F5
Mean	0.139996	0.1430	0.1356	0.1362	0.1345
StDev	0.0115	0.0105	0.0102	0.0087	0.0096
CV	8.2407	7.3732	7.5215	6.3846	7.1554
Min	0.1213	0.1230	0.1230	0.1220	0.1245
Max	0.1584	0.1615	0.1524	0.1523	0.1484

	Barley ($/BU) Base 2017	Barley ($/BU) F5	Barley ($/BU) L7F5	Barley ($/BU) LJTF12	Barley ($/BU) L12F5
Mean	4.5067	4.4867	4.8171	4.7224	4.8439
StDev	0.7402	0.8075	0.7424	0.6825	0.7084
CV	16.4244	17.9970	15.4122	14.4529	14.6251
Min	3.5166	3.4025	3.7303	3.6996	3.7313
Max	6.0161	6.2076	6.1229	6.1043	6.0071

	Canola ($/LB) Base 2017	Canola ($/LB) F5	Canola ($/LB) L7F5	Canola ($/LB) LJTF12	Canola ($/LB) L12F5
Mean	0.1711	0.1656	0.1704	0.1712	0.1664
StDev	0.0293	0.0284	0.0290	0.0304	0.0259
CV	17.1022	17.1373	17.0263	17.7294	15.5674
Min	0.1374	0.1288	0.1345	0.1359	0.1364
Max	0.2347	0.2234	0.2224	0.2280	0.2112

	Oats ($/BU) Base 2017	Oats ($/BU) F5	Oats ($/BU) L7F5	Oats ($/BU) LJTF12	Oats ($/BU) L12F5
Mean	2.4659	2.4504	2.4018	2.4164	2.1474
StDev	0.6103	0.6502	0.5834	0.5715	0.4359
CV	24.7502	26.5331	24.2916	23.6526	20.2971
Min	1.5828	1.4853	1.4576	1.5337	1.3401
Max	3.4576	3.6045	3.3885	3.3198	2.8219

	Peas ($/LB) Base 2017	Peas ($/LB) F5	Peas ($/LB) L7F5	Peas ($/LB) LJTF12	Peas ($/LB) L12F5
Mean	0.1198	0.1122	0.1111	0.1150	0.1100
StDev	0.0307	0.0314	0.0281	0.0278	0.0247
CV	25.6026	28.0221	25.2515	24.2156	22.4440
Min	0.0711	0.0679	0.0698	0.0717	0.0692
Max	0.1704	0.1795	0.1821	0.1693	0.1627

	Sunflower ($/LBS) Base 2017	Sunflower ($/LBS) F5	Sunflower ($/LBS) L7F5	Sunflower ($/LBS) LJTF12	Sunflower ($/LBS) L12F5
Mean	0.1719	0.1636	0.1717	0.1742	0.1706
StDev	0.0361	0.0359	0.0352	0.0324	0.0304
CV	21.0012	21.9446	20.4785	18.6005	17.8191
Min	0.1262	0.1203	0.1296	0.1311	0.1315
Max	0.2470	0.2460	0.2478	0.2404	0.2273

	Cotton Base 2017	Cotton F5	Cotton L7F5	Cotton LJTF12	Cotton L12F5
Mean	0.6743	0.6668	0.6757	0.6773	0.6748
StDev	0.1226	0.1172	0.1065	0.1061	0.0998
CV	18.1864	17.5806	15.7606	15.6667	14.7914
Min	0.5332	0.5468	0.5470	0.5644	0.5567
Max	0.9085	0.9300	0.9202	0.9096	0.8803

Table 4.1. Baseline and Alternative MYA Price Simulation Results

To test the probable farmer preferences, one must analyze how ARC and PLC parameters are affected by alternative MYA price series. Stochastic 2017 ARC and PLC government payments were simulated for the baseline and each alternative MYA price series calculation methods.

Results for the Baseline

The baseline MYA prices were simulated using a MVEMP as percent deviations from trend to simulate the 2017 ARC and PLC payments for each crop. Table 4.2 shows the results of the baseline simulation.

The means represent the projected average government payments paid to farmers for ARC and PLC. The largest projected government payments for ARC in 2017 were for corn. This is not surprising because over 93% of corn base acres are enrolled in ARC, ($90 million acres) additionally, corn prices are also relatively low compared to the reference price. The lowest ARC payment was for long grain rice due in part to the number of base acres and low ARC participation. Peanuts remained unchanged with no ARC payments made due to zero participation[9]. The highest PLC mean payment was for wheat and the lowest was for medium grain rice.

The probability of triggering (frequency of payments) an ARC or PLC payment under the baseline was also calculated for each crop (table 4.2). PLC has an overall higher probability of triggering a payment (excluding cotton and peanuts) between 40% to 88% compared to ARC,

[9] Peanuts had a national 0.3% participation rate under ARC therefore, for simplicity purposes, a 0% participation rate was used in this analysis.

which has a frequency of payments percentage between 19% to 68%. This was expected, as low prices over the past four years have caused ARC's revenue guarantee to decline while PLC reference prices have remained constant. The average total payment size under ARC ($4,335 million) is double that of PLC ($2,709.82 million). Overall, baseline PLC payments are issued more often than ARC payments, however, when ARC payments do trigger, they are usually much larger than PLC.

Table 4.2. Baseline Results of ARC and PLC for Each Covered Commodity (In Millions of Dollars)

		Corn	Soybeans	Sorghum	Wheat	Peanuts	LG Rice	MG Rice
ARC	Mean	$ 2,964.4	$ 861.2	$ 37.4	$ 422.5	$ -	$ 0.1	$ 7.4
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 4,985	$ 2,256	$ 64	$ 814	$ -	$ 1	$ 24
	% time paid	65%	41%	68%	59%	0%	32%	64%
PLC	Mean	$ 442.5	$ 23.5	$ 296.9	$ 2,303.8	$ 256.9	$ 593.5	$ 0.1
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 1,026	$ 84	$ 619	$ 2,304	$ 494	$ 1,043	$ 0
	% time paid	71%	40%	79%	69%	86%	88%	62%

		Barley	Canola	Oats	Peas	Sunflowers	Cotton	Total
ARC	Mean	$ 19.5	$ 0.1	$ 12.5	$ 2.1	$ 8.4	$ -	$ 4,335.6
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 15
	Max	$ 44	$ 1	$ 23	$ 11	$ 19	$ -	$ 8,228
	% time paid	54%	19%	60%	51%	55%	0%	
PLC	Mean	$ 109.9	$ 63.7	$ 6.0	$ 2.2	$ 37.8	$ -	$ 2,709.8
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 402
	Max	$ 272	$ 118	$ 21	$ 11	$ 82	$ -	$ 5,136
	% time paid	73%	81%	54%	57%	66%	0%	

Results for Alternative 1: The First Five Marketing Year

Alternative one (F5) was simulated using the first five monthly marketings to calculate the annual MYA commodity prices. This section summarizes the changes in ARC and PLC payments for alternative F5, compared to the baseline. The ARC payment frequency and the magnitude of payments increased for most crops compared to the base (table 4.3). Under F5, the average ARC frequency increased 3%. The only crop that decreased in frequency of payments was medium grain rice, by 2%. Also, the average change in ARC payments for corn increased almost $300 million; wheat and soybeans also had large increases of $93 million and $77 million respectively. In PLC under F5, long grain rice had a loss of $62 million annually. In contrast, wheat experienced the largest increase in mean PLC payments (over $161 million).

Under the F5 marketing year, ARC payments totaled $4,812 million, which is an increase of almost $476 million from the total baseline payments. Total PLC payments were $2,907 million, which is about $197 million greater than the baseline total of $2,118.9 million (Tables 4.2 & 4.3). Table 4.3 shows that the F5 MYA price calculation, compared to the base, increases taxpayer spending on ARC and PLC payments by a total of $673 million annually.

Table 4.3. First Five Marketing Year Results of ARC and PLC for Each Covered Commodity (In Millions of Dollars)

		Corn	Soybeans	Sorghum	Wheat	Peanuts	LG Rice	MG Rice
ARC	Mean	$ 3,267	$ 938	$ 39	$ 516	$ -	$ 0	$ 6
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 5,027	$ 2,249	$ 63	$ 829	$ -	$ 1	$ 25
	% time paid	73%	48%	72%	68%	0%	32%	62%
Change from Base	Mean	$ 302.88	$ 77.23	$ 1.74	$ 93.05	$ -	$ 0.02	$ (1.01)
	% time paid	9%	7%	4%	9%	0%	0%	-2%
PLC	Mean	$ 489	$ 30	$ 332	$ 2,465	$ 281	$ 531	$ 0
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 1,083	$ 90	$ 665	$ -	$ 536	$ 1,093	$ 0
	% time paid	79%	42%	84%	78%	86%	88%	30%
Change from Base	Mean	$ 46.90	$ 6.74	$ 35.56	$ 161.50	$ 24.09	$ (62.11)	$ (0.03)
	% time paid	7%	3%	5%	10%	1%	0%	-32%

		Barley	Canola	Oats	Peas	Sunflowers	Cotton	Total
ARC	Mean	$ 21	$ 0	$ 13	$ 2	$ 8	$ -	$ 4,812
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 51
	Max	$ 45	$ 1	$ 23	$ 5	$ 18	$ -	$ 8,284
	% time paid	58%	27%	62%	53%	58%	0%	
Change from Base	Mean	$ 1.52	$ 0.03	$ 0.85	$ 0.02	$ 0.00	$ -	$ 476.33
	% time paid	4%	7%	2%	2%	3%	0%	
	Mean	$ 118	$ 71	$ 7	$ 3	$ 46	$ -	$ 2,907
PLC	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 385
	Max	$ 293	$ 134	$ 23	$ 12	$ 89	$ -	$ 5,428
	% time paid	71%	86%	56%	59%	81%	0%	
Change from Base	Mean	$ 7.92	$ 6.88	$ 0.59	$ 1.21	$ 8.34	$ -	$ 196.75
	% time paid	-2%	4%	3%	2%	16%	0%	

Results for Alternative Two: Last 7 First 5 Month Marketing Year

Alternative two (L7F5) used the last seven, and the first five monthly marketing values of the marketing year to calculate MYA commodity prices. The results in Table 4.4 show how each crop, simulated under ARC and PLC programs, respond to the L7F5 MYA calculation when compared to the unchanged base.

The ARC payment frequency and magnitude of payments increased for all crops except for barley (Tables 4.2 & 4.4). On average, ARC frequency increased 12% under L7F5 compared to the baseline. Barley decreased the probability of triggering a payment by 5% and mean payment by $1.6 million. Corn, wheat and soybeans had the largest ARC payment increases of $1,040, $248 and $158.4 million respectively. Peanuts remained unchanged with no ARC payments.

PLC saw large decreases in the size of mean payments. The decrease was largely caused by long grain rice, which experienced the largest decrease in payments compared to the base of $516 (Tables 4.2 & 4.4). Wheat experienced the largest increase in mean PLC payments (over $215 million) followed by peanuts with a $87.6 million payment increase.

Under the L7F5 marketing year, total ARC payments were $5,795 million, which is an increase of almost $1,460 million from the total baseline payments. Total PLC payments were $2,514 million, which is around $195 million less than the baseline total of $2,118 million (Tables 4.2 & 4.4). Table 4.4 shows that the L7F5 alternative, compared to the baseline, substantially increases taxpayer spending on ARC and PLC by $1,264 million annually.

Table 4.4. Last Seven First Five (L7F5) Results of ARC and PLC for Each Covered Commodity (In Millions of Dollars)

		Corn	Soybeans	Sorghum	Wheat	Peanuts	LG Rice	MG Rice
ARC	Mean	$ 4,004.4	$ 1,019.5	$ 40.1	$ 670.5	$ -	$ 0.4	$ 13.6
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 5,564.0	$ 2,370.6	$ 67.1	$ 889.6	$ -	$ 0.6	$ 24.6
	% time paid	77%	59%	72%	83%	0%	64%	77%
Change from Base	Mean	$ 1,040.0	$ 158.4	$ 2.7	$ 248.0	$ -	$ 0.2	$ 6.2
	% time paid	12%	18%	4%	24%	0%	32%	12%
PLC	Mean	$ 412.6	$ 21.9	$ 262.1	$ 2,519.0	$ 344.5	$ 77.0	$ 63.4
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 974.3	$ 90.6	$ 653.9	$ -	$ 616.1	$ 231.2	$ 123.3
	% time paid	72%	33%	83%	91%	92%	58%	79%
Change from Base	Mean	$ (29.9)	$ (1.6)	$ (34.8)	$ 215.2	$ 87.6	$ (516.5)	$ 63.3
	% time paid	1%	-6%	4%	22%	6%	-31%	17%
		Barley	**Canola**	**Oats**	**Peas**	**Sunflowers**	**Cotton**	**Total**
ARC	Mean	$ 17.9	$ 0.3	$ 15.6	$ 2.8	$ 9.8	$ -	$ 5,794.9
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 45.2
	Max	$ 45.6	$ 0.9	$ 24.1	$ 5.2	$ 19.6	$ -	$ 9,012.0
	% time paid	50%	48%	69%	62%	64%	0%	
Change from Base	Mean	$ (1.6)	$ 0.2	$ 3.0	$ 0.7	$ 1.4	$ -	$ 1,459.3
	% time paid	-5%	29%	9%	12%	9%	0%	
PLC	Mean	$ 77.0	$ 63.4	$ 6.5	$ 2.8	$ 39.4	$ -	$ 2,514.7
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 563.3
	Max	$ 231.2	$ 123.3	$ 24.0	$ 11.3	$ 78.5	$ -	$ 4,991.1
	% time paid	58%	79%	59%	51%	79%	0%	
Change from Base	Mean	$ (32.9)	$ (0.3)	$ 0.5	$ 0.6	$ 1.6	$ -	$ (195.1)
	% time paid	-15%	-2%	5%	-6%	13%	0%	

Results for Alternative Three: Last January to First 12 Month Marketing Year

Alternative three (LJTF12) used monthly marketing values beginning in January of the previous marketing year, continuing through the next entire marketing year (January-August, September-August) to calculate MYA commodity prices. The results in Table 4.5 show how each crop, simulated under ARC and PLC programs, respond to the LJTF12 MYA calculation.

The ARC payment frequency increased for all crops except for sorghum and barley (Tables 4.2 & 4.5). The probability of triggering a payment decreased by 30% for sorghum and 3% for barley. There was also an average 7% increase in ARC frequency under LJTF12 compared to the baseline (from 43% to 50% average). The mean payments for sorghum and barley decreased by $15.8 million and $2.9 million. Corn and wheat had the largest mean payment increases of $325.6 million and $109.5 million.

PLC saw large drops in mean payments and the frequency of payments. The largest decreases were observed for sorghum, which experienced a substantial 22% payment decrease, followed by corn and barley with 8% (Tables 4.2 & 4.5). Long grain rice had the largest increase in mean PLC payments by $801 million, followed by wheat with a $51.6 million increase.

Under LJTF12, ARC payments totaled $4,737 million, which is an increase of almost $304 million from the total baseline payments. Total PLC payments were $2,835.9 million, which is around $717 million more than the baseline total of $2,119 million (Tables 4.2 & 4.5). Table 4.5 shows the LJTF12 alternative, compared to the baseline, increases taxpayer spending on ARC and PLC by $7,573.4 million annually.

Table 4.5 LJTF12 Results of ARC and PLC for Each Covered Commodity (In Millions of Dollars)

		Corn	Soybeans	Sorghum	Wheat	Peanuts	LG Rice	MG Rice
ARC	Mean	$ 3,290	$ 839	$ 22	$ 532	$ -	$ 0	$ 12
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 5,430	$ 2,341	$ 67	$ 839	$ -	$ 1	$ 24
	% time paid	69%	47%	39%	68%	0%	62%	80%
Change from Base	Mean	$ 326	$ (22)	$ (15.83)	$ 109	$ -	$ 0	$ 12
	% time paid	4%	6%	-30%	9%	0%	30%	15%
PLC	Mean	$ 378	$ 18	$ 141	$ 2,355	$ 300	$ 806	$ 0
	Min	$ -	$ -	$ -	$ -	$ -	$ 267	$ -
	Max	$ 954	$ 67	$ 429	$ -	$ 566	$ 1,136	$ 0
	% time paid	62%	33%	57%	76%	88%	100%	69%
Change from Base	Mean	$ (64)	$ (5)	$ (156)	$ 52	$ 44	$ 801	$ 0
	% time paid	-9%	-7%	-22%	7%	2%	12%	7%

		Barley	Canola	Oats	Peas	Sunflowers	Cotton	Total
ARC	Mean	$ 17	$ 0	$ 14	$ 2	$ 9	$ -	$ 4,737
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 57
	Max	$ 45	$ 1	$ 24	$ 5	$ 20	$ -	$ 8,796
	% time paid	51%	49%	66%	59%	56%	0%	
Change from Base	Mean	$ (2.92)	$ 0	$ 2	$ (104)	$ 0	$ -	$ 304
	% time paid	-3%	30%	6%	22%	1%	0%	
PLC	Mean	$ 80	$ 63	$ 6	$ 3	$ 35	$ -	$ 2,836
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 731
	Max	$ 237	$ 121	$ 22	$ 11	$ 77	$ -	$ 5,192
	% time paid	65%	77%	55%	56%	75%	0%	
Change from Base	Mean	$ (30)	$ (0)	$ 0	$ 3	$ (3)	$ -	$ 717
	% time paid	-8%	-4%	2%	56%	10%	0%	

Results for Alternative Four: Last 12 First 5 Month Marketing Year

Alternative four (L12F5) used the last seven, and the first five monthly marketing values of the marketing year to calculate MYA commodity prices. The results in Table 4.6 show how each crop, simulated under ARC and PLC programs, respond to the L12F5 MYA calculation when compared to the unchanged baseline.

The ARC payment frequency increased for all crops except for barley (Tables 4.2 & 4.6). There was also an average 17% overall increase in ARC frequency under L12F5 compared to the baseline. Barley decreased the probability of triggering a payment by 7% and the mean payment by almost $4.2 million. The mean for ARC corn payments increased by $761 million under L12F5, followed by wheat with an increase of $208 million. On the other hand, peas had the most substantial payment decrease of $104 million.

PLC saw large increases in mean payments and frequency of payments. Peas had the largest increase in payment frequency of 55%, followed by wheat and sorghum with 27% and 21% respectively (Tables 4.2 & 4.6). Long grain rice experienced the largest increase in mean PLC payments with $893 million, followed by wheat and sorghum with increases of $184 million and $120 million.

Under the L12F5, ARC payments totaled $5,314 million, which is a considerable increase of $881 million from the total baseline payments ($4,433 million). Total PLC payments were $3,553 million, which is $1,434 million greater than the baseline total of $2,118.9 million (Tables 4.2 & 4.6). L12F5 MYA price calculation, compared to the baseline, increases taxpayer spending on ARC and PLC payments by a total of $1,559.5 million annually.

Table 4.6 L12F5 Results of ARC and PLC for Each Covered Commodity (In Millions of Dollars)

		Corn	Soybeans	Sorghum	Wheat	Peanuts	LG Rice	MG Rice
ARC	Mean	$ 3,726	$ 831	$ 63	$ 631	$ -	$ 0	$ 15
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Max	$ 5,430	$ 2,341	$ 67	$ 839	$ -	$ 1	$ 25
	% time paid	74%	46%	98%	85%	0%	70%	81%
Change from Base	Mean	$ 761	$ (31)	$ 26	$ 208	$ -	$ 0	$ 15
	% time paid	9%	5%	30%	25%	0%	38%	16%
PLC	Mean	$ 382	$ 17	$ 417	$ 2,488	$ 366	$ 898	$ 0
	Min	$ -	$ -	$ 16	$ -	$ -	$ 523	$ -
	Max	$ 924	$ 75	$ 684	$ -	$ 654	$ 1,194	$ 0
	% time paid	72%	31%	100%	96%	92%	100%	64%
Change from Base	Mean	$ (61)	$ (7)	$ 120	$ 184	$ 109	$ 893	$ 0
	% time paid	1%	-8%	21%	27%	6%	12%	3%
		Barley	**Canola**	**Oats**	**Peas**	**Sunflowers**	**Cotton**	**Total**
ARC	Mean	$ 15	$ 0	$ 18	$ 3	$ 11	$ -	$ 5,314
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 81.19
	Max	$ 45	$ 1	$ 24	$ 5	$ 20	$ -	$ 8,797
	% time paid	48%	54%	87%	65%	65%	0%	
Change from Base	Mean	$ (4)	$ 0	$ 6	$ (104)	$ 2	$ -	$ 881
	% time paid	-7%	35%	27%	27%	10%	0%	
PLC	Mean	$ 71	$ 67	$ 9	$ 3	$ 38	$ -	$ 3,553
	Min	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,440
	Max	$ 231	$ 120	$ 27	$ 11	$ 76	$ -	$ 5,684
	% time paid	58%	82%	70%	55%	78%	0%	
Change from Base	Mean	$ (39)	$ 4	$ 3	$ 3	$ 0	$ -	$ 1,434
	% time paid	-15%	1%	17%	55%	13%	0%	

Risk Ranking Alternatives

Stochastic efficiency with respect to a function (SERF) graphs were created from the simulation results for each ARC and PLC MYA formulas to compare the base and alternative prices. SERF analysis is a relatively transparent and straight-forward method of risk ranking that simultaneously ranks all alternatives. The SERF analysis was conducted to rank producers and taxpayer's preferences for each of the risky alternatives. This section includes analysis for three main crops: corn, soybeans, and wheat. SERF results for all other crops are included in Appendix B.

PLC Rankings

Figures 4.1 – 4.3 show the SERF results from ranking the risky MYA price series alternatives for PLC. The SERF charts show the risk rankings for alternative risky scenarios and risk averse decision makers who range from risk neutral to extremely risk averse. This analysis assumes decision makers (producers and taxpayers) are risk averse and will choose the alternative with the highest return and the lowest risk.

This SERF analysis uses a negative exponential utility function as well as minimum and maximum absolute risk aversion coefficient's (ARAC's). The lower ARAC is set equal to zero (risk neutral) and the upper ARAC (extremely risk averse) is found by dividing the relative risk coefficient (4) by the expected farm net worth. The upper ARAC value using ARC corn payments calculation:

Max ARAC = (relative risk coefficient/net worth)

*= (4 / 3,141 * 10)*

= 0.0001

For simplicity purposes, the same upper ARAC value of 0.0001 was used for all crops under ARC and PLC because it was found that the magnitudes changed, but the risk rankings remained constant when using 0.0001 for each crop.

SERF calculates the certainty equivalent (CE) (in millions of dollars) for each risky alternative at 25 different ARAC levels between the lower and upper ARAC's. The highest CE line is preferred at each ARAC level. If the CE line do not cross, then all decisions for a risk averse decision maker prefer the alternative with the highest CE line. Risk premiums are how much a decision maker would pay to move from one risky alternative to another and it visually displayed in the SERF charts as the vertical distance between the CE lines at each ARAC level.

As one would expect, results show large differences in preferences between crops. The F5 MYA was the alternative preferred by producers for corn and soybeans, but L12F5 was preferred by wheat. Taxpayer preferences for MYA prices are assumed to be the opposite as they prefer lower expenditure and thus rank the CE line that is the lowest as preferred. For corn, the preferred alternative for the taxpayer is L12F5, because it is the MYA price series with the lowest CE (figure 4.1). This is followed by LJTF12, L7F5, the baseline and lastly F5.

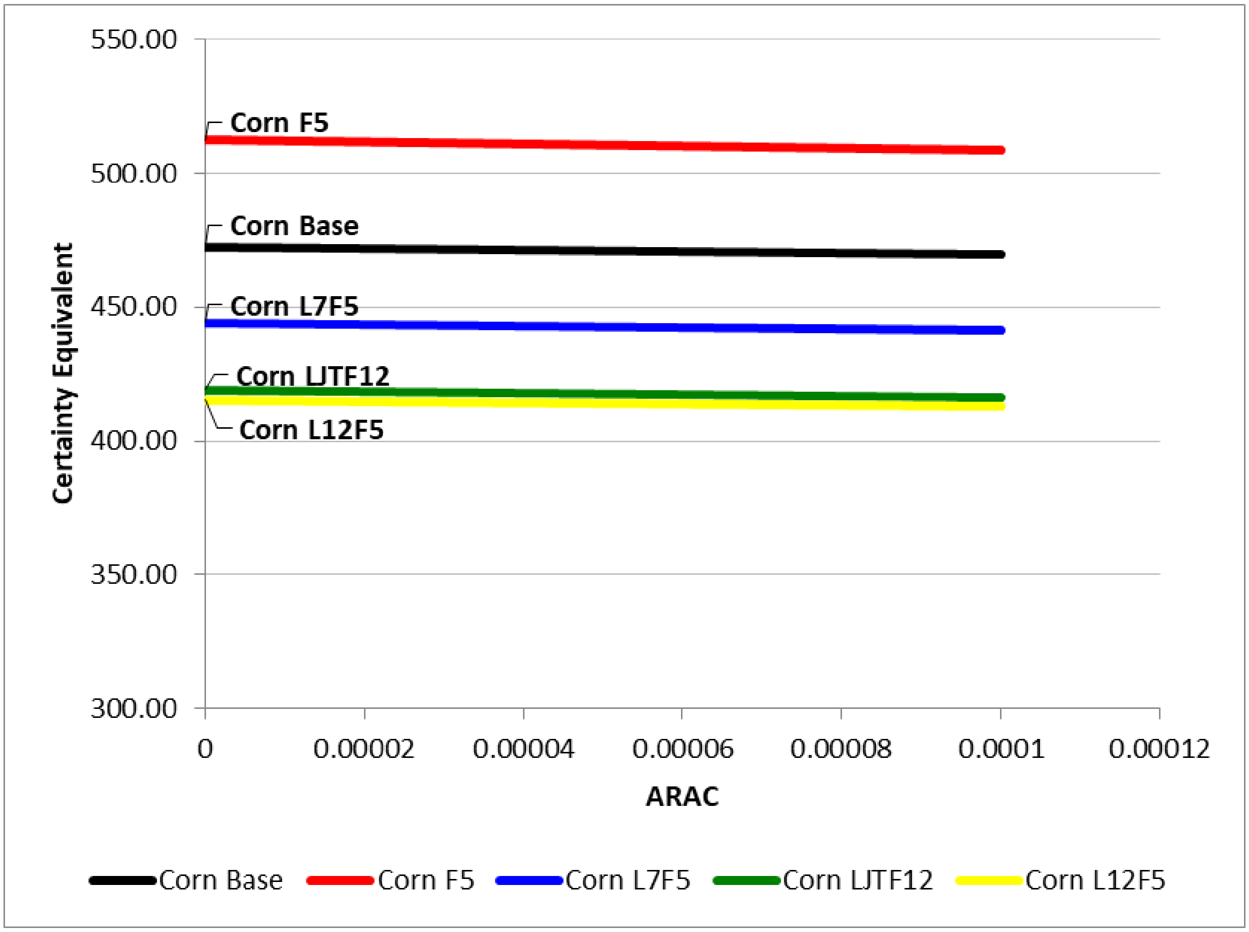

Figure 4.1. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for corn PLC payments for 5 Scenarios for Corn.

Figure 4.2 ranks the alternative preferences for soybeans based on total PLC payments for the taxpayer and farmers. As previously stated, F5 is the preferred MYA alternative for soybean producers. However, unlike corn, the taxpayer preferred price series is LJTF12. The next preferred alternative is L12F5, followed by the base, L7F5 and F5, respectively.

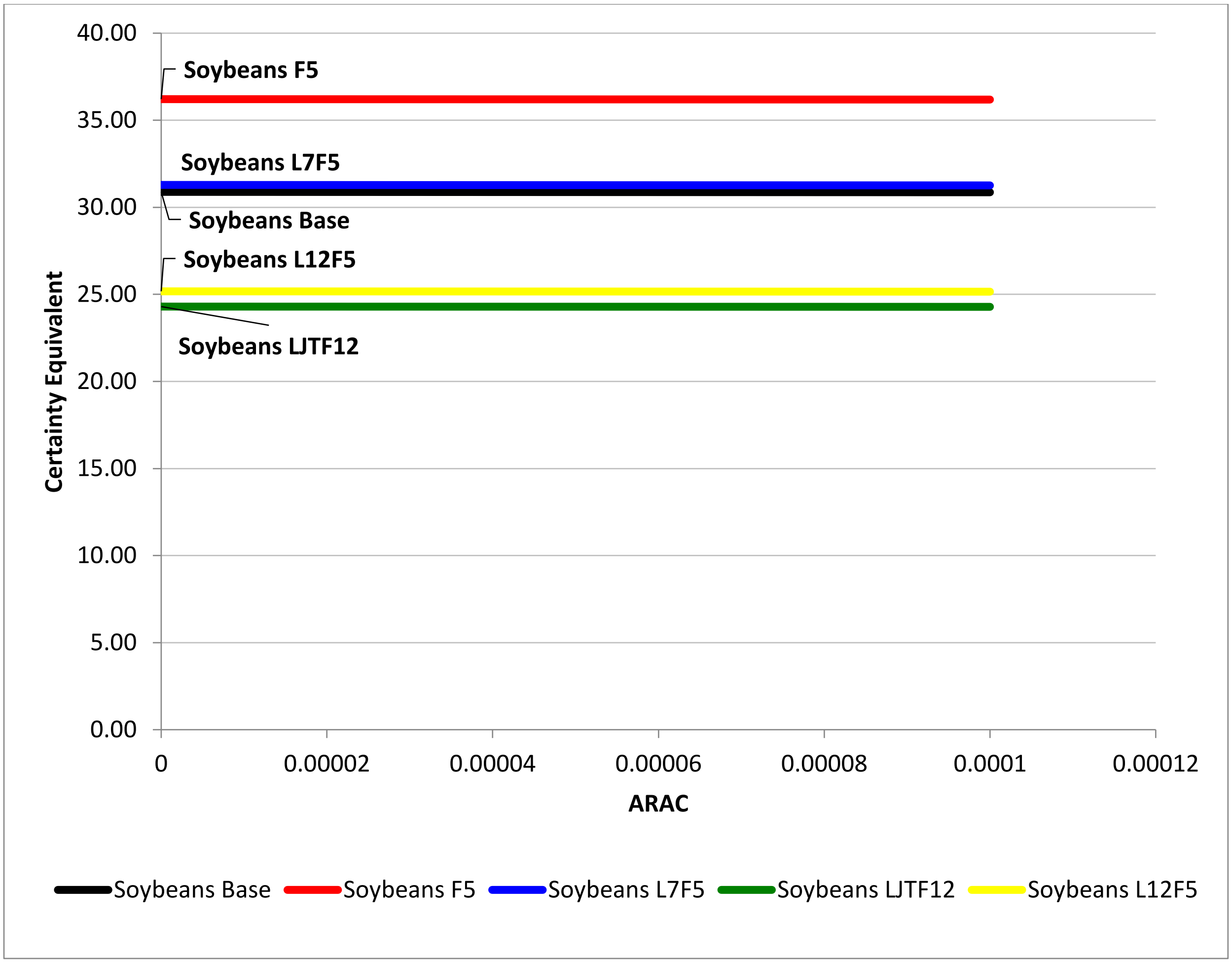

Figure 4.2. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for soybean PLC payments for 5 Scenarios for Soybeans.

Taxpayer price series preferences for wheat are shown in figure 4.3. Much different from corn and soybeans, the preferred MYA price alternative for wheat producers is L12F5, while the preferred MYA price series for the taxpayer is the wheat baseline. The baseline is followed by the alternative LJTF12, F5 and L7F5, respectively.

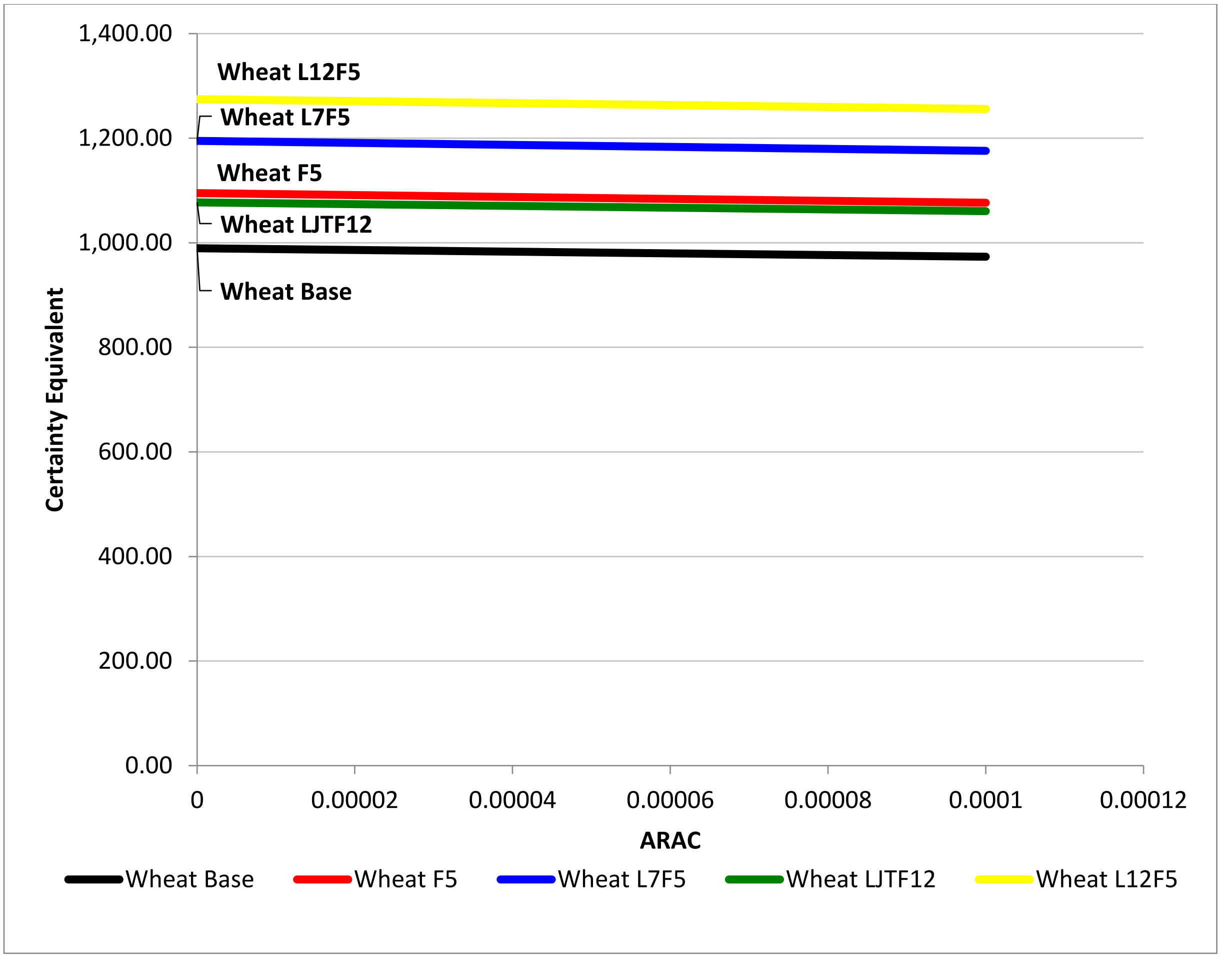

Figure 4.3. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for wheat PLC payments for 5 Scenarios for Wheat.

ARC Rankings

Figures 4.4 – 4.6 show the SERF graphs from ranking risky alternative MYA price series for ARC. As one would expect, results show variation in preferences between different crops. However, the L7F5 was the preferred alternative for farmers three out of the three crops shown in this section.

Figure 4.4 shows the preferred MYA price alternative for farmers and taxpayer under ARC. ARC and PLC payments are calculated very differently so the preferred alternative for farmers and taxpayer are also very different. The preferred alternative for corn farmers when calculating ARC is L7F5, while taxpayers preferred the MYA price baseline instead. The baseline is followed by F5, LJTF12 and L12F5.

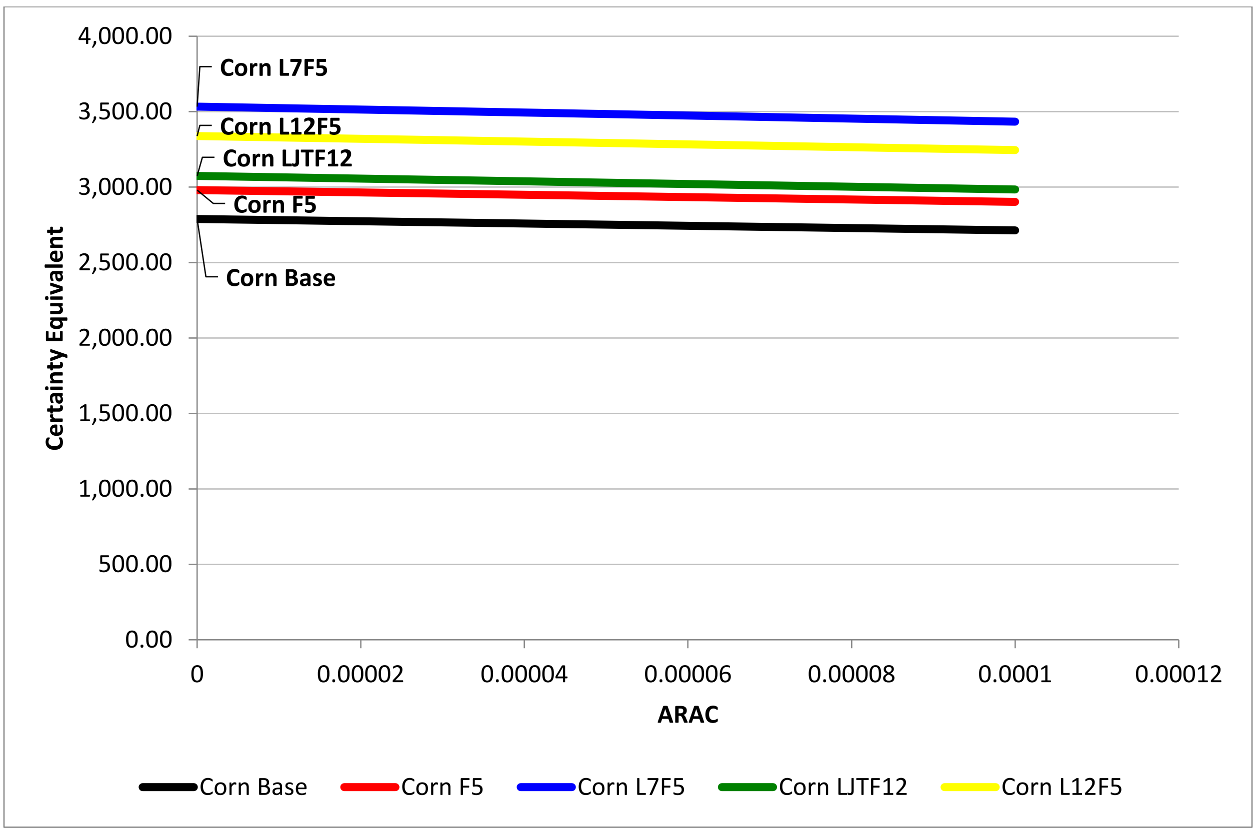

Figure 4.4. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for corn ARC payments for 5 Scenarios for Corn.

Figure 4.5 depicts the risk rankings for soybeans. Corn and soybean farmers have the same preference when calculating ARC and PLC. The preferred alternative for soybean producers is L7F5. The preferred alternative for the taxpayer is L12F5 with the soybean baseline and LJTF12 being almost equally preferred.

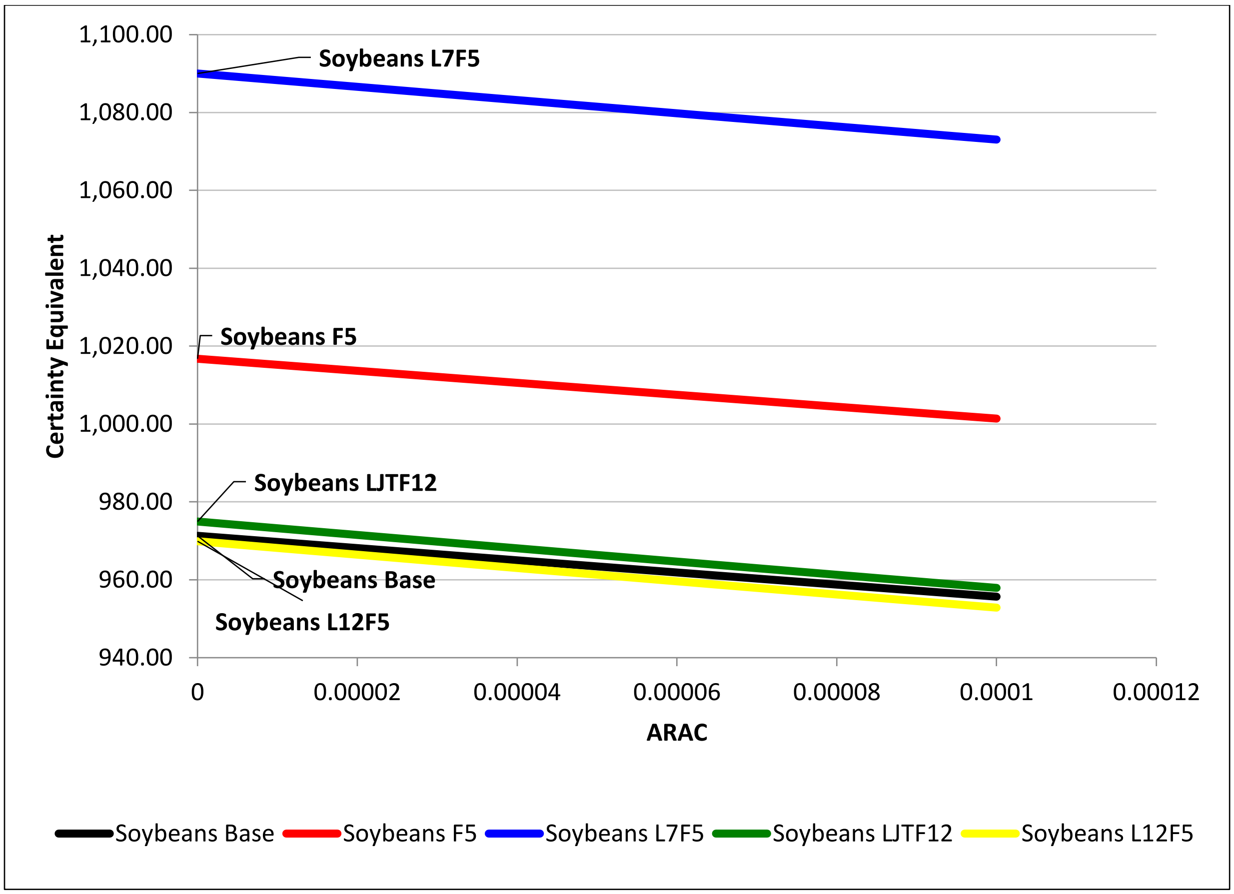

Figure 4.5. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for Soybean ARC payments for 5 Scenarios for Soybeans.

The preferred alternatives for wheat based on ARC payments for taxpayers and farmers are shown in figure 4.6. When calculating ARC, wheat farmers have the same preferred alternative as corn and soybean farmers, which is completely different when calculated with PLC. The preferred MYA price alternative for wheat farmers is L7F5, while taxpayers preferred the wheat baseline. When calculating ARC, the wheat and corn preferred alternatives are identical even though they both have different marketing years.

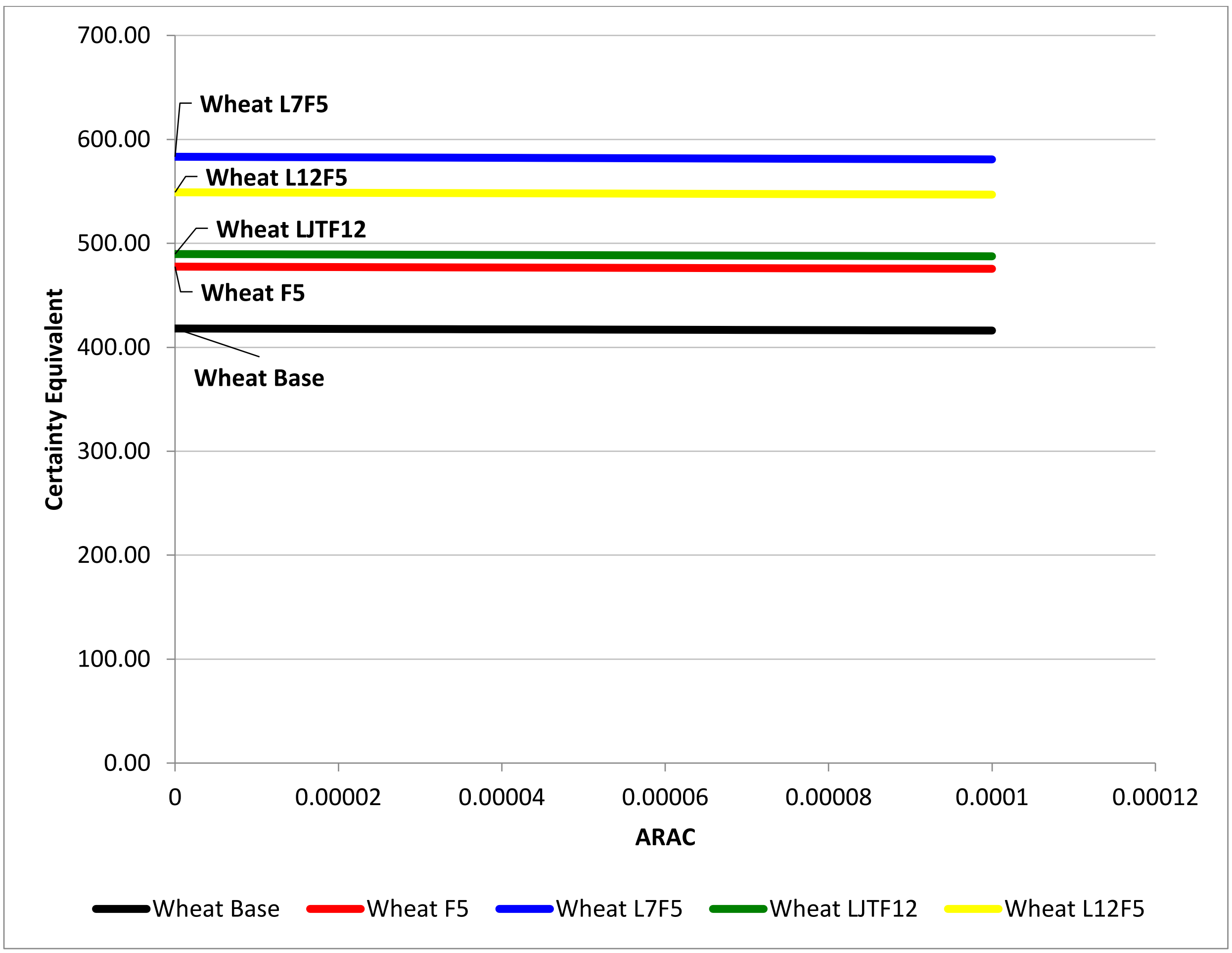

Figure 4.6. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for wheat ARC payments for 5 Scenarios for Wheat.

Table 4.7 is a summarization of producer and taxpayer rankings of each alternative MYA price series for all 13 crops for PLC and ARC. There is a lot of differentiation between the crop preferences, making it difficult to find a clear-cut preferred alternative for both producers and taxpayers. The baseline scenario under ARC and PLC, was preferred by the taxpayers for 8 out of 13 crops (no other alternative was close). Producers preferences were not so straightforward. Under ARC and PLC, producers ranked the L12F5 scenario first for 9 out of 13 crops.

With the interest of lowering the federal budget, taxpayers, prefer the baseline MYA price scenario, for ARC and PLC because it is the least costly alternative. While most farmers prefer the L12F5 alternative MYA price scenario, as it has the highest ARC and PLC program payments. The purpose was to find one MYA price series that producers and taxpayers could agree on for every crop, under ARC and PLC. Therefore, because there was not one single alternative that both parties could agree upon, no conclusions can be drawn at this point, and farther analysis is needed.

Because no single alternative was unanimously agreed upon, farther analysis was conducted to get producers perspectives on the decision. To get input from producers, the results of this research were presented to various national farm associations and agricultural interest groups by the Chief Economist for the House Agricultural Committee, Bart Fischer. Results showed that for each crop, farmers would benefit by switching from the baseline to any of the four MYA price series alternatives because ARC and PLC payments would be received sooner and would be larger.

Despite seeing that they would benefit by switching from the baseline, producers still chose the baseline MYA price series. It is inferred that farmers are extremely risk averse. This is proven by the fact that they would rather take a smaller but familiar amount of money farther in the future, than have a larger but uncertain amount of money sooner. This decision tells a lot about how farmers feel about risk. Because although they saw that for every crop, under each alternative, they would receive larger payments sooner than they would under the baseline, they still chose to risk the possibility of going bankrupt waiting to receive government payments (14 months after harvest) rather than face the risk and uncertainty associated with new policy.

The purpose of this research was to find one MYA price series alternative that was unanimously preferred by both producers and taxpayers. However, there was no alternative that was found to be unanimously preferred by the taxpayers and farmers. Therefore, additional research conducted by the Chief Economist of the House Agricultural Committee found that the current 12-month baseline is preferred by both taxpayers and producers. Furthermore, the baseline MYA price series will be used in the upcoming 2018 Farm Bill to calculate ARC and PLC payments.

Table 4.7 SERF Producer and Government Rankings Preferences

	Corn		Soybeans		Wheat		Sorghum		Canola	
PLC	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**
1st	F5	L12F5	F5	LJTF12	L12F5	Base	L12F5	LJTF12	F5	Base
2nd	Base	LJTF12	L7F5	L12F5	L7F5	LJTF12	F5	L7F5	L12F5	LJTF12
3rd	L7F5	L7F5	Base	Base	F5	F5	Base	Base	L7F5	L7F5
4th	LJTF12	Base	L12F5	L7F5	LJTF12	L7F5	L7F5	F5	LJTF12	L12F5
5th	L12F5	F5	LJTF12	F5	Base	L12F5	LJTF12	L12F5	Base	F5
ARC	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**
1st	L7F5	Base	L7F5	L12F5	L7F5	Base	L12F5	LJTF12	L12F5	Base
2nd	L12F5	F5	F5	Base	L12F5	F5	L7F5	Base	LJTF12	F5
3rd	LJTF12	LJTF12	LJTF12	LJTF12	LJTF12	LJTF12	F5	F5	L7F5	L7F5
4th	F5	L12F5	Base	F5	F5	L12F5	Base	L7F5	F5	LJTF12
5th	Base	L7F5	L12F5	L7F5	Base	L7F5	LJTF12	L12F5	Base	L12F5

	Sunflowers		Peas		Oats		Barley		MG Rice	
PLC	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**
1st	F5	LJTF12	F5	Base	L12F5	Base	F5	L12F5	L7F5	-
2nd	L7F5	L12F5	L12F5	LJTF12	L7F5	LJTF12	Base	L7F5	-	-
3rd	Base	Base	L7F5	L7F5	F5	F5	LJTF12	LJTF12	-	-
4th	L12F5	L7F5	LJTF12	L12F5	LJTF12	L7F5	L7F5	Base	-	-
5th	LJTF12	F5	Base	F5	Base	L12F5	L12F5	F5	-	L7F5
ARC	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**
1st	L12F5	F5	L12F5	Base	L12F5	Base	F5	L12F5	L12F5	F5
2nd	L7F5	Base	L7F5	F5	L7F5	F5	Base	LJTF12	L7F5	Base
3rd	LJTF12	LJTF12	LJTF12	LJTF12	LJTF12	LJTF12	L7F5	L7F5	LJTF12	LJTF12
4th	Base	L7F5	F5	L7F5	F5	L7F5	LJTF12	Base	Base	L7F5
5th	F5	L12F5	Base	L12F5	Base	L12F5	L12F5	F5	F5	L12F5

	LG Rice		Peanuts		Cotton	
PLC	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**
1st	L12F5	L7F5	L12F5	Base	-	-
2nd	LJTF12	F5	L7F5	F5	-	-
3rd	Base	Base	LJTF12	LJTF12	-	-
4th	F5	LJTF12	F5	L7F5	-	-
5th	L7F5	L12F5	Base	L12F5	-	-
ARC	**Producers**	**Govt.**	**Producers**	**Govt.**	**Producers**	**Govt.**
1st	L12F5	Base	-	-	-	-
2nd	L7F5	F5	-	-	-	-
3rd	LJTF12	LJTF12	-	-	-	-
4th	F5	L7F5	-	-	-	-
5th	Base	L12F5	-	-	-	-

Taxpayer Costs

The baseline and four alternative MYA price series calculations were each compared to the Congressional Budget Office's (CBO's) 2017 projected government payments. This comparison was conducted to quantify the cost differences between the calculation methods. Government payments are reflected in the results as the sum of each programs' mean payment for 13 crops (table 4.8). The same reference price is assumed for both the base and the alternatives with the only difference being the formula to calculate the MYA prices.

Table 4.8 Average Annual Government Payments for ARC plus PLC by Crop, 2017

	Corn 2017	SB 2017	GS 2017	Wht 2017	Peanuts 2017	LGR 2017	MGR 2017
Baseline	3,407	885	334	1,299	257	594	7
F5	3,757	969	372	1,513	281	532	6
L7F5	4,417	1,041	302	1,815	345	77	77
SLJTF12	3,668	857	163	1,536	300	807	12
L12F5	4,108	847	481	1,916	366	899	15
CBO	1,784	892	348	1,670	244	-	-

	Barley 2017	Canola 2017	Oats 2017	Dry Peas 2017	Sunflowers 2017	Cot 2017	TOTALS
Baseline	129	64	19	4	46	-	7,045
F5	139	71	20	6	55	-	7,719
L7F5	95	64	22	6	49	-	8,310
SLJTF12	97	64	21	5	44	-	7,573
L12F5	86	68	27	6	49	-	8,867
CBO	81	86	19	6	46	-	5,176

Baseline and each alternative price series assume the same reference price

CHAPTER V

SUMMARY AND CONCLUSION

Due to the current deflated state of the American agricultural economy and the high cost of production, it is becoming increasingly important for farmers to have access to credit. Producers are calling on Congress to find a way to allow commodity program payments to be estimated and received sooner than the current system. Policy makers need the best information possible, to make an informative decision as to the consequences of changing the MYA price calculation for PLC and ARC calculations. The objectives of this research were to evaluate alternative payment timing options by calculating a new MYA price for determining PLC and ARC payments.

A stochastic multivariate empirical simulation model was used to include price and production risk into the simulated outcomes. Four alternative price series were used to simulate MYA prices for each covered commodity and compared against the baseline price series (the current 12-month MYA price). The model was designed to provide probabilistic outcomes for each alternative marketing year average prices. The model was used to analyze 13 crops under a baseline MYA price formula compared to four alternative MYA price formulas and used to calculate both ARC and PLC.

The current 2014 MYA price formula was used as the basis for comparison in this farm policy analysis. Thirteen covered commodities were analyzed under the current 12 month MYA. Four alternative MYA price series were calculated and compared against the baseline. To determine the effects of the alternative price series' formulas on farm program payment timing, the current twelve-month MYA formula was used as the basis for comparison in the model.

The first alternative, F5, calculates MYA prices using the first five monthly marketing values of the marketing year. The second alternative, L7F5, was calculated using the last seven months of the current year and the first five months of the upcoming year. The third alternative, LJTF12, three uses monthly marketings beginning in January of the current marketing year and continues through the next entire crop year. Finally, the fourth alternative, L12F5, uses the last twelve months of the current year and the first five months of the next year.

Alternative one (F5) MYA price when compared to the baseline performed well among the farmers. For producers five out of the 13 crops preferred alternative F5 to the baseline and the other three alternatives. When tested, this alternative was preferred by canola farmers with PLC, barley farmers with both PLC and ARC, soybean farmers with PLC, and corn farmers with PLC. Also, when tested, the taxpayers favored alternative F5 for only two out of the 13 crops. Sunflowers with ARC and medium grain rice with ARC.

Alternative two (L7F5) MYA price when compared to the baseline and the other three alternatives was not as preferred by farmers as alternative one (F5). L7F5 was preferred only by three of the 13 crops. Corn with ARC, wheat with ARC, and soybean with ARC. Taxpayers did not prefer alternative LJTF12 for ARC or PLC for any of the crops.

Alternative three (LJTF12) MYA price when compared to the baseline and the other three alternatives performed poorly for farmers. LJTF12 was preferred by the taxpayers for three out of the 13 crops. Sunflower with PLC, sorghum with both PLC and ARC, and soybeans with PLC. Farmers did not prefer alternative LJTF12 over the baseline or the other three alternatives.

Alternative four (L12F5) when compared to the baseline and the other three alternatives performed exceptionally for farmers. Nine out of the 13 crops preferred L12F5 to the other alternatives for producers. Sunflowers with ARC, peas with ARC, oat farmers with both PLC and ARC, canola with ARC, medium grain rice farmers with ARC, long grain rice farmers with ARC, peanut farmers with PLC, wheat farmers with PLC, and sorghum farmers with both PLC and ARC. L12F5 was preferred by taxpayers for three out of the 13 crops. Taxpayers favored L12F5 for barley with both PLC and ARC, soybeans with ARC, and corn with PLC.

Conclusions

In the current state of the American agricultural economy, it is becoming increasingly more difficult for farmers to cash flow and to obtain operating loans from lenders. For this reason, Congress is working to find a solution to get farmers paid quicker than they are now, under the current 2014 Farm Bill. This research was conducted with the purpose of finding an alternative price series solution to the payment timing problems associated with the ARC and PLC programs.

A series of MYA price calculations were evaluated and compared to the current baseline MYA price series calculation to identify effects on the timing and amount of farm program payments. Results show most farmers prefer the L12F5 alternative but are overall undecided on which alternative they prefer. However, in this farm policy analysis, to meet federal budgetary limitations, the alternative with the lowest CE is likely preferred by the taxpayers. Therefore, taxpayers will prefer the current 12 month baseline MYA price series. Because there was not one single alternative that both parties could agree upon, no assumptions can be drawn at this point, and farther analysis is needed.

Farther analysis was conducted to get producers perspectives on the decision. The results of this research were presented to various national farm associations and agricultural interest groups by the Chief Economist for the House Agricultural Committee, Bart Fischer. Despite seeing that they would benefit by switching from the baseline, producers still chose the baseline MYA price series. It is inferred that farmers are extremely risk averse because they would rather have a smaller but familiar amount of money farther in the future, than have a larger but uncertain amount of money sooner. Furthermore, the baseline MYA price series will be used in the upcoming 2018 Farm Bill to calculate ARC and PLC payments.

REFERENCES

"ARC/PLC Program." *United States Department of Agriculture Farm Service Agency*, www.fsa.usda.gov/programs-and-services/arcplc_program/index.

"Coefficient of Variation - CV." *Investopedia*, 1 Apr. 2016, www.investopedia.com/terms/c/coefficientofvariation.asp.

"Crop Commodity Program Provisions-Title I." United States Department of Agriculture Economic Research Service, par 1. www.ers.usda.gov/topics/farm-economy/farm-commodity-policy/crop-commodity-program-provisions-title-i.aspx.

"Crop Commodity Programs." *USDA ERS - Crop Commodity Programs*, www.ers.usda.gov/agricultural-act-of-2014-highlights-and-implications/crop-commodity-programs/.

"Drafting the Next Farm Bill" *Farm Bill | House Agriculture Committee*, agriculture.house.gov/farmbill/. Accessed Feb. 2017.

"FAPRI 2018 U.S. Baseline Briefing Book." 2018. FAPRI UMC Report #01-18. Food and Agricultural Policy Research Institute, University of Missouri-Columbia, March. 2018.

"Farm Bill: A Short History and Summary." *Farm Policy Facts*, par. 5. www.farmpolicyfacts.org/farm-policy-history/. Accessed 15 February 2018.

"Final Market-Year Prices Detail PLC Payments, But ARC-County Numbers Likely Next Week." *KTIC Radio*, 3 Oct. 2017, kticradio.com/agricultural/final-market-year-prices-detail-plc-payments-but-arc-county-numbers-likely-next-week/.

"Glossary." *U.S. Senate:* 23 Jan. 2017, www.senate.gov/reference/glossary_term/fiscal_year.htm.

"National Association of Wheat Growers the Next Farm Bill: Commodity Policy, Part 1." 2017, p. 11.

"National Association of Wheat Growers the Next Farm Bill: Commodity Policy, Part 1." 2017, p. 11.

"National Barley Growers Association the Next Farm Bill: Commodity Policy, Part 1." 2017, p. 2.

"National Sorghum Producers the Next Farm Bill: Commodity Policy, Part 1 Testimony." 2017, p. 5.

Erik J. O'Donoghue, Ashley E. Hungerford, Joseph C. Cooper, Thomas Worth, and Mark Ash. *The 2014 Farm Act Agriculture Risk Coverage, Price Loss Coverage, and Supplemental Coverage Option Programs' Effects on Crop Revenue*, ERR-204, U.S. Department of Agriculture, Economic Research Service, January 2016, pp. 1, www.ers.usda.gov/webdocs/publications/45512/56418_err-204.pdf?v=42381. Accessed 6 Mar. 2018.

Higgins, L.M., J.W. Richardson, J.L. Outlaw, and J.M. Raulston. 2007. "Farm Level Impacts of a Revenue Based Policy in the 2007 Farm Bill." Paper presented at the American Agricultural Economics Association annual meeting, Portland OR, 29 July -1 August.

Knapek, George M (2013). An Economic Analysis of U.S. Farm Programs Including Senate and House Farm Bills on Representative Farms. Doctoral dissertation, Texas A&M University. Available electronically from www.hdl .handle .net /1969 .1 /149555.

National Agricultural Statistics Service. 2017. "Ag Statistics Database." U.S. Department of Agriculture. Washington DC.

Outlaw, J.L., J.W. Richardson, C.P. Rosson III, D.A. Klinefelter, D.P. Anderson, and R. D. Knutson. 2008. *Policy Tools for US Agriculture,* 4th ed. College Station, TX: Texas A&M University Agricultural and Food Policy Center.

Reprinted form. Johnson, Renee (2017). Previewing a 2018 Farm Bill (CRS Report No. R44784). Retrieved from: www.nationalaglawcenter.org/wp-content/uploads//assets/crs/IF10638.pdf; p. 13.

Reprinted form. "National Association of Wheat Growers the Next Farm Bill: Commodity Policy, Part 1." 2017, p. 3.

Reprinted form. United States; Department of Agriculture; Farm Service Agency; ARC/PLC Program Data; 8 Mar. 2018; Table 1.

Richardson, J. W., S. L. Klose, and A. W. Gray. 2000. "An Applied Procedure for Estimating and Simulating Multivariate Empirical (Mve) Probability Distributions in Farm-Level Risk Assessment and Policy Analysis." Journal of Agricultural and Applied Economics 32 (2):299-315.

Richardson, J., K. Schumann, and P. Feldman. *Simetar Simulation & Econometrics to Analyze Risk*. Simetar, Inc., 2008, simetar.com/Portals/18/Simetar%202011%20Users%20Manual.pdf.

Richardson, J., K. Schumann, and P. Feldman. *Simetar Simulation & Econometrics to Analyze Risk*. Simetar, Inc., 2008, www.simetar.com/Portals/18/Simetar%202011%20Users%20Manual.pdf.

Richardson, J.W., S.L. Klose, and A.W. Gray. 2000. "An Applied Procedure for Estimating and Simulating Multivariate Empirical (MVE) Probability Distributions in Farm-Level Risk

Assessment and Policy Analysis." Journal of Agricultural and Applied Economics 32(2): 299-315.

Richardson, James W. "Applied Simulation: Computer Modeling: Simulation Encyclopedia of Agriculture (Forthcoming)." MS No. 127 ed., www.afpc.tamu.edu/courses/622/reading/Applied-Simulation-Chapter-Sept-09-2013.pdf.

Shurley, Don, and Adam N Rabinowitz. *Estimated ARC and PLC Payments for 2016 Covered Commodities*. UGA Cooperative Extension, 2017, *Estimated ARC and PLC Payments for 2016 Covered Commodities*, www.caes.uga.edu/content/dam/caes-website/departments/agricultural-and-applied-economics/documents/extension/Decision%20Aids/estimated-ARC-PLC-payments-2016-covered-commodities.pdf

Wallace, Siobhan. "Payment and Loan Programs." *The 2014 Farm Bill*, 2014, www.thefarmbill.com/title-1-payments-loans.

APPENDIX A

Seasonal Price Index Equation:

Stochastic Monthly Price Forecast $_{n1}$ *= [(adjusted stochastic indices* month $_{n1}$) * *(FAPRI projected 2017 MYA price)]*

Note: This calculation is done for all 12 months.

Fractional Contribution Index Equations:

i.) *Stochastic Monthly Sales Forecast* $_{n1}$ *= [(adjusted stochastic fractional indices* $_{n1}$*) * (FAPRI projected 2017 annual production)]*

ii.) *Monthly Sales Weight* $_{n1}$*= (stochastic monthly sales forecast* $_{n1}$ */ FAPRI projected annual production) * 100]*

Note: These calculations are done for all 12 months.

APPENDIX B

Note all certainty equivalent (CEs) are measured in millions of dollars.

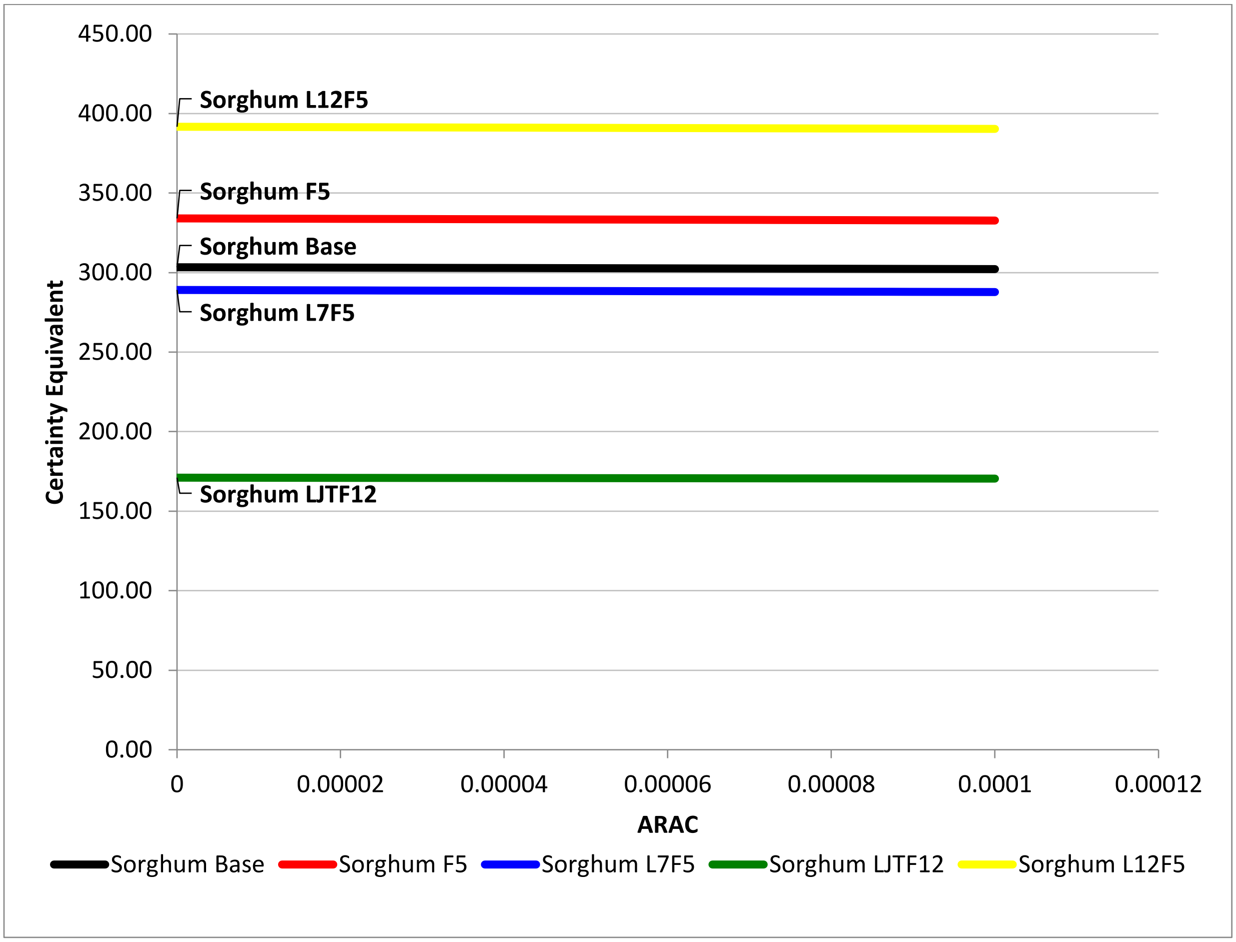

Figure B.1. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Sorghum.

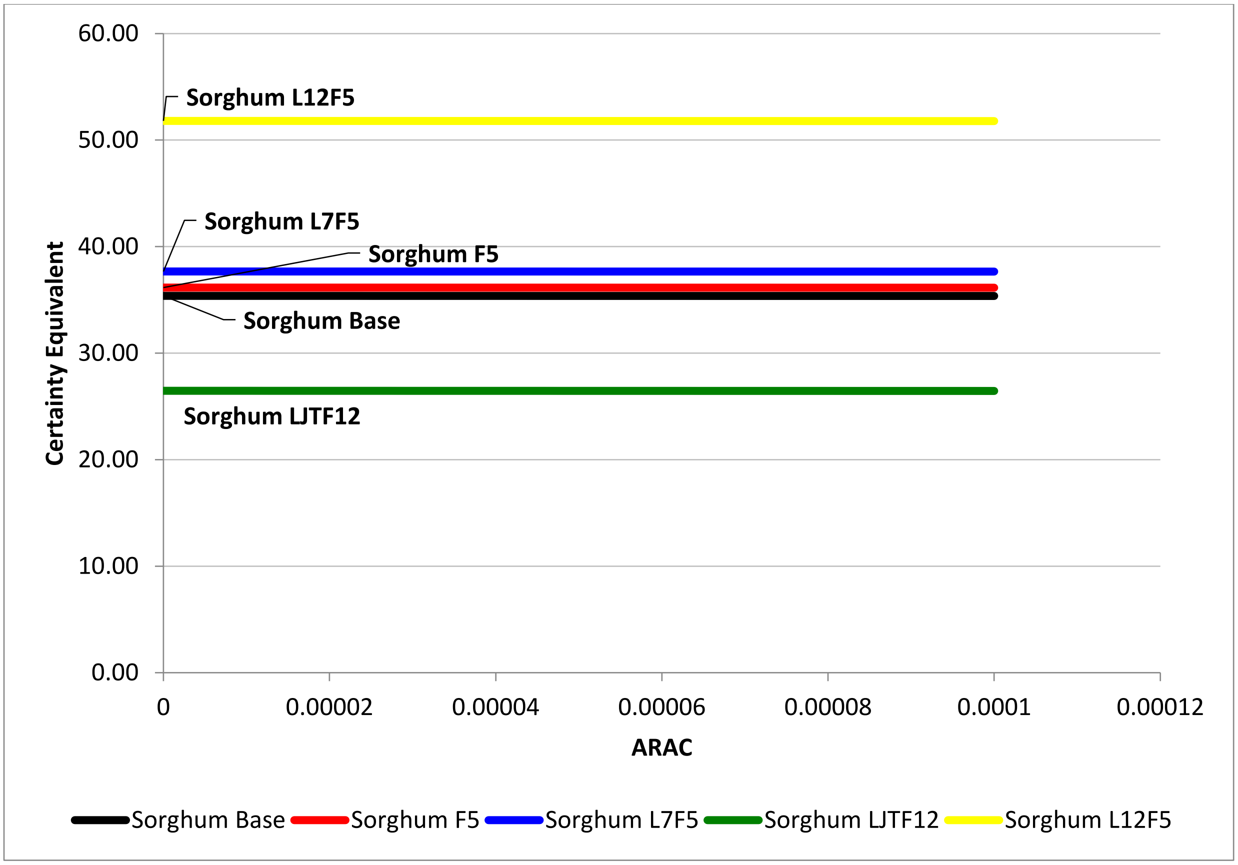

Figure B.2. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Sorghum.

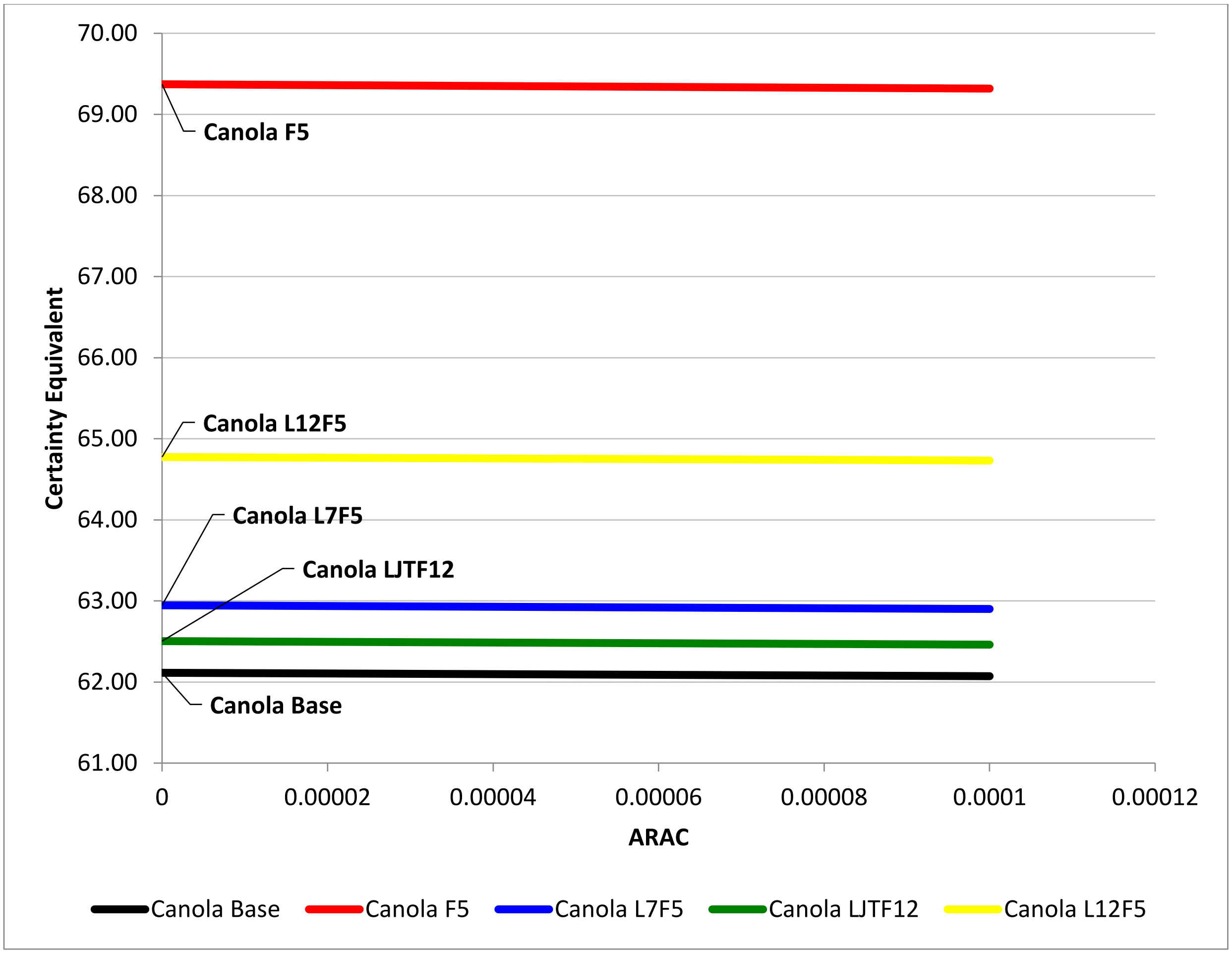

Figure B.3. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Canola.

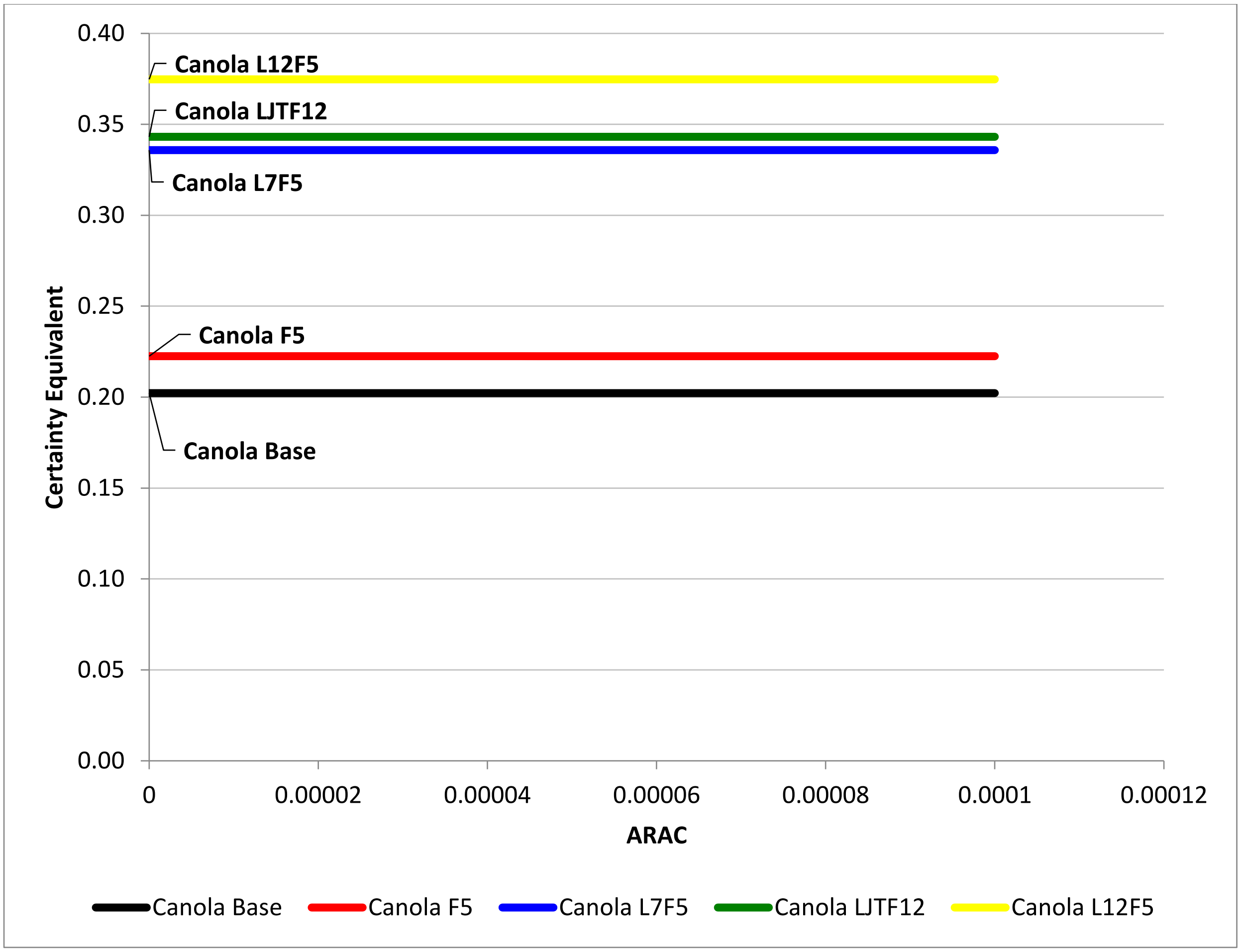

Figure B.4. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Canola.

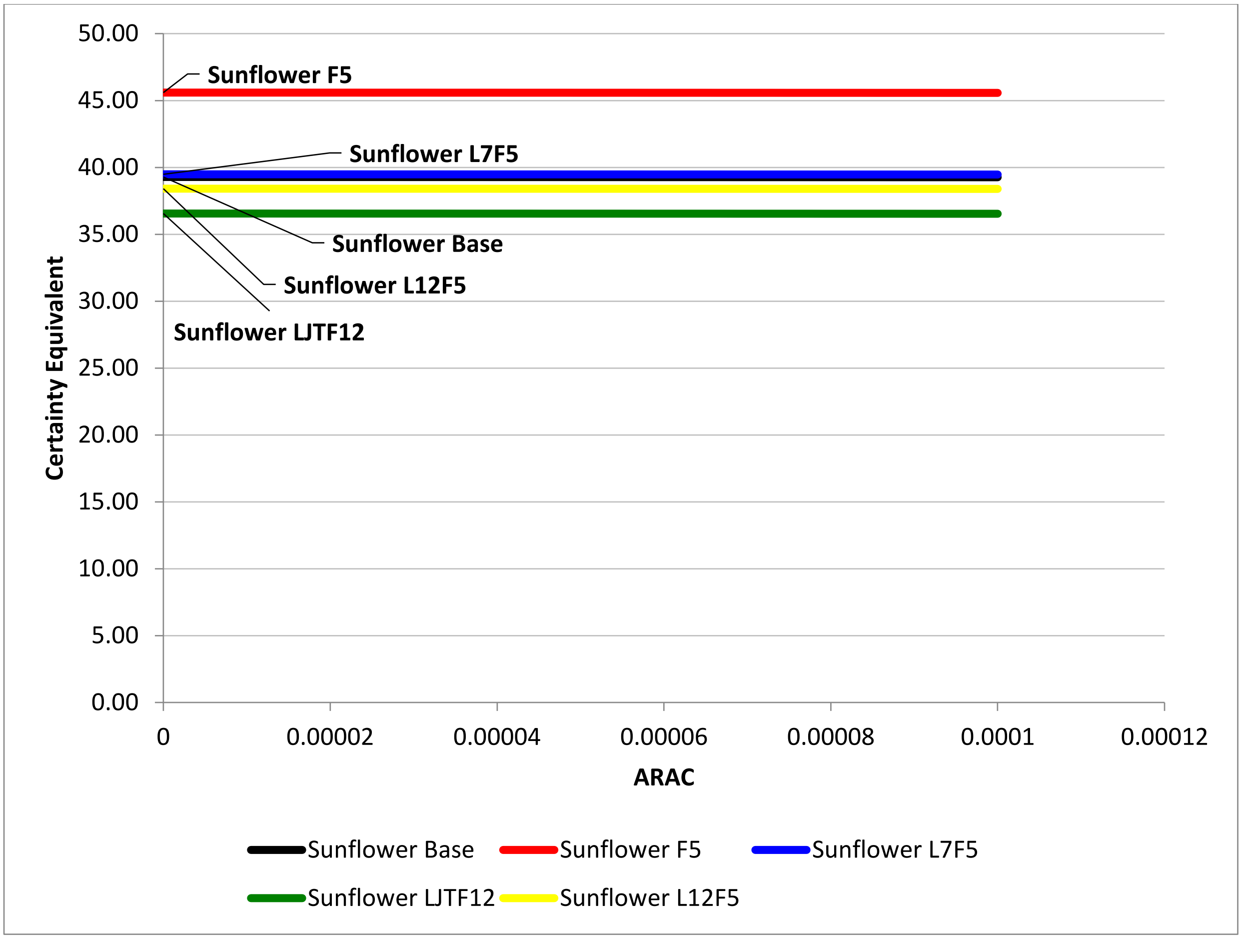

Figure B.5. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Sunflowers.

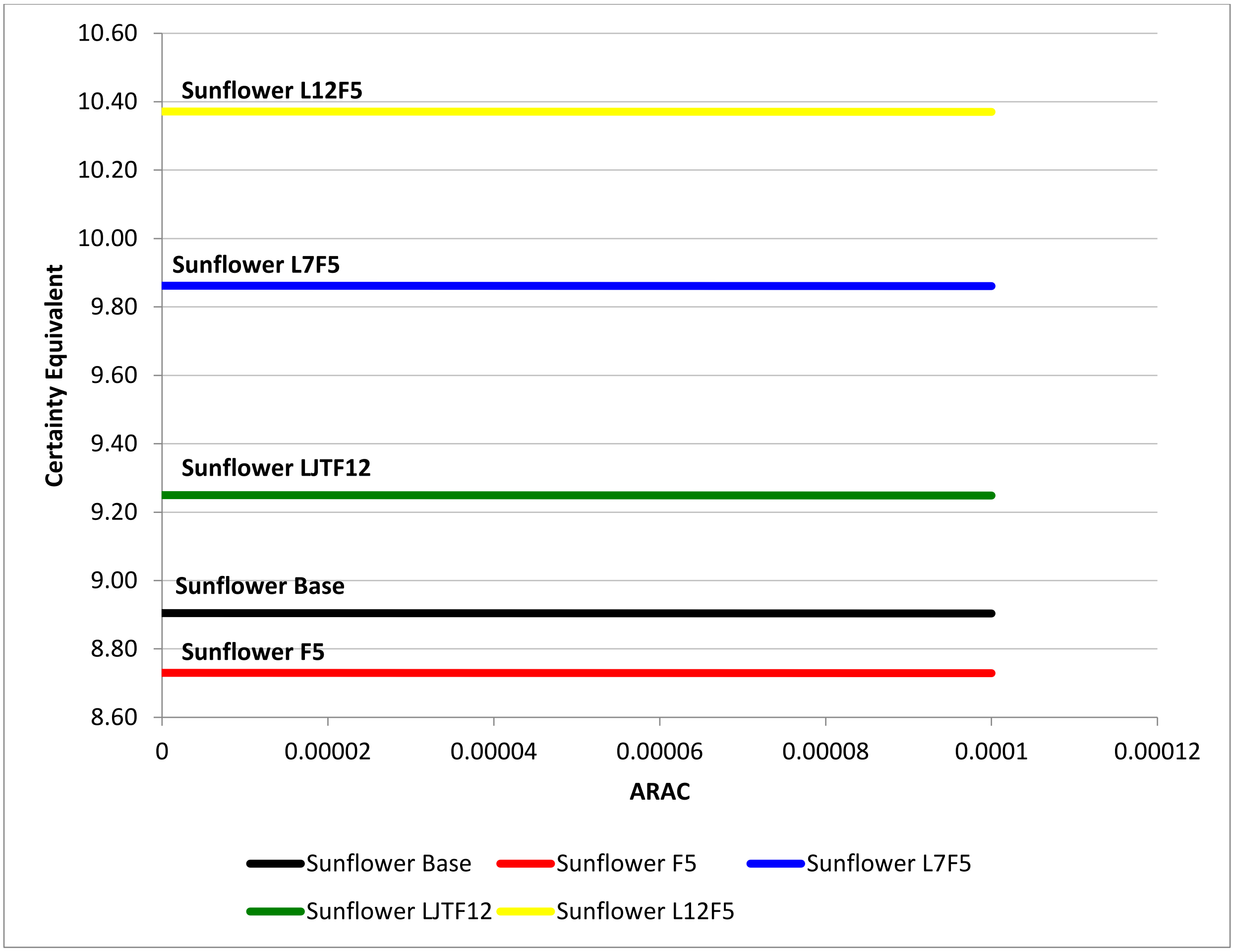

Figure B.6. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Sunflowers.

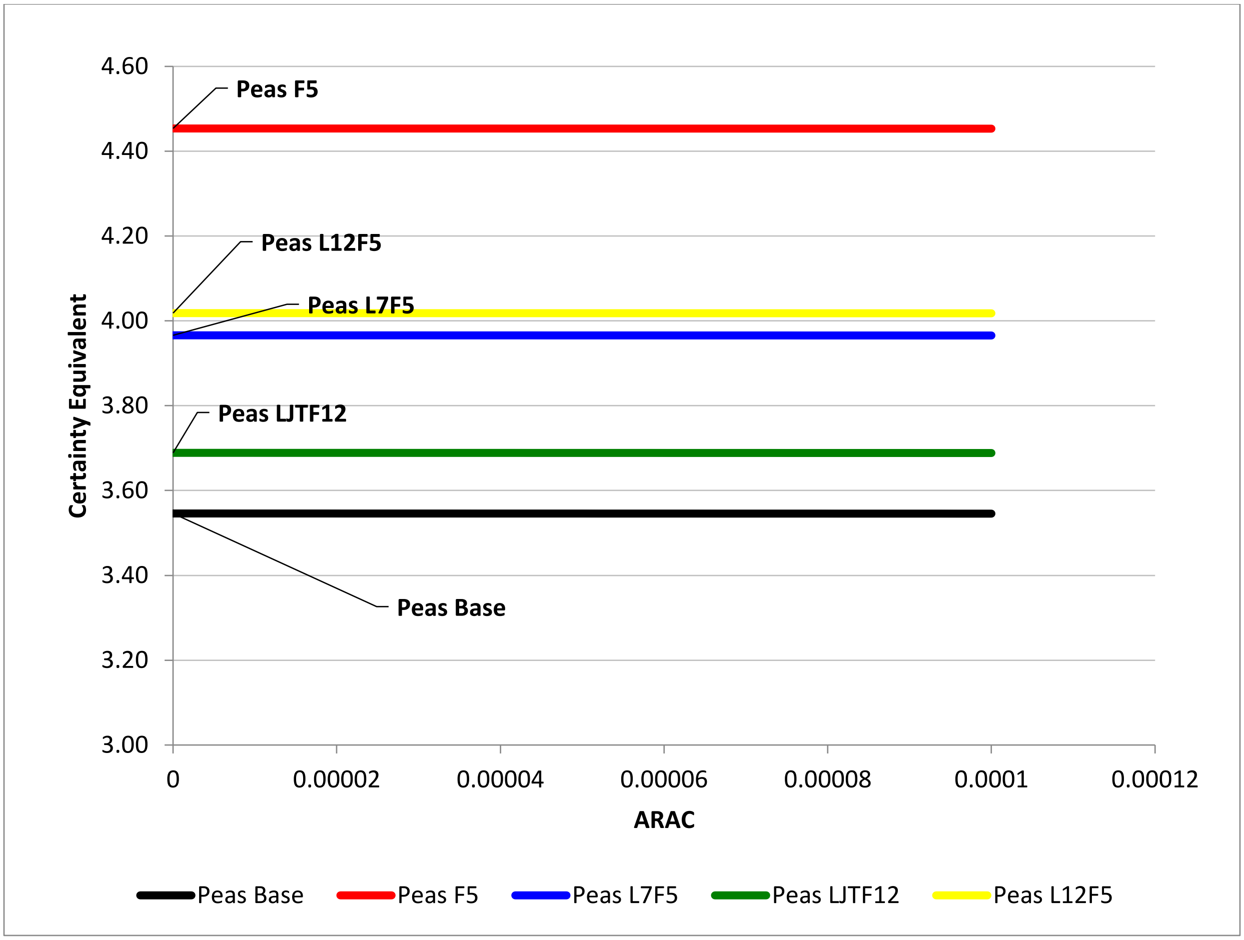

Figure B.7. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Peas.

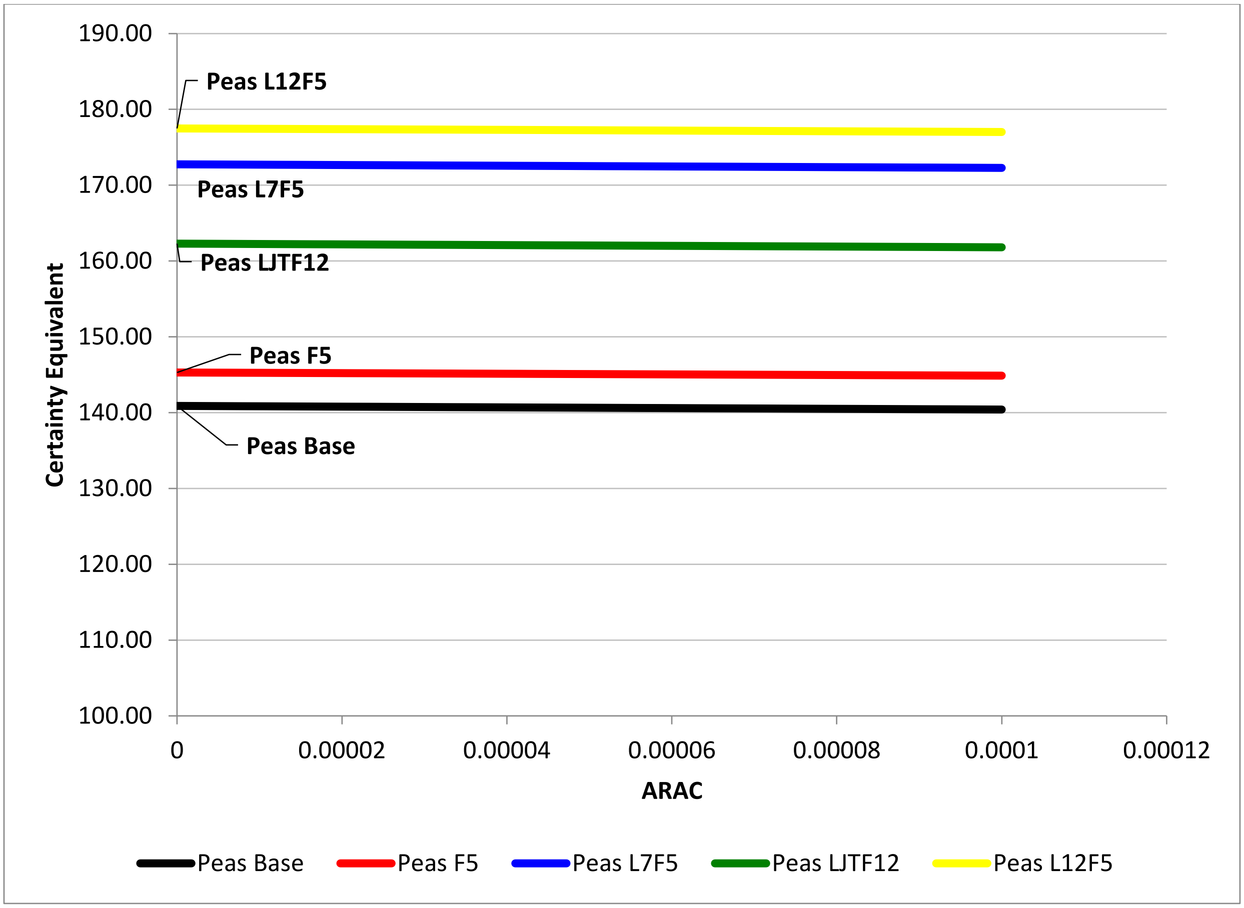

Figure B.8. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Peas.

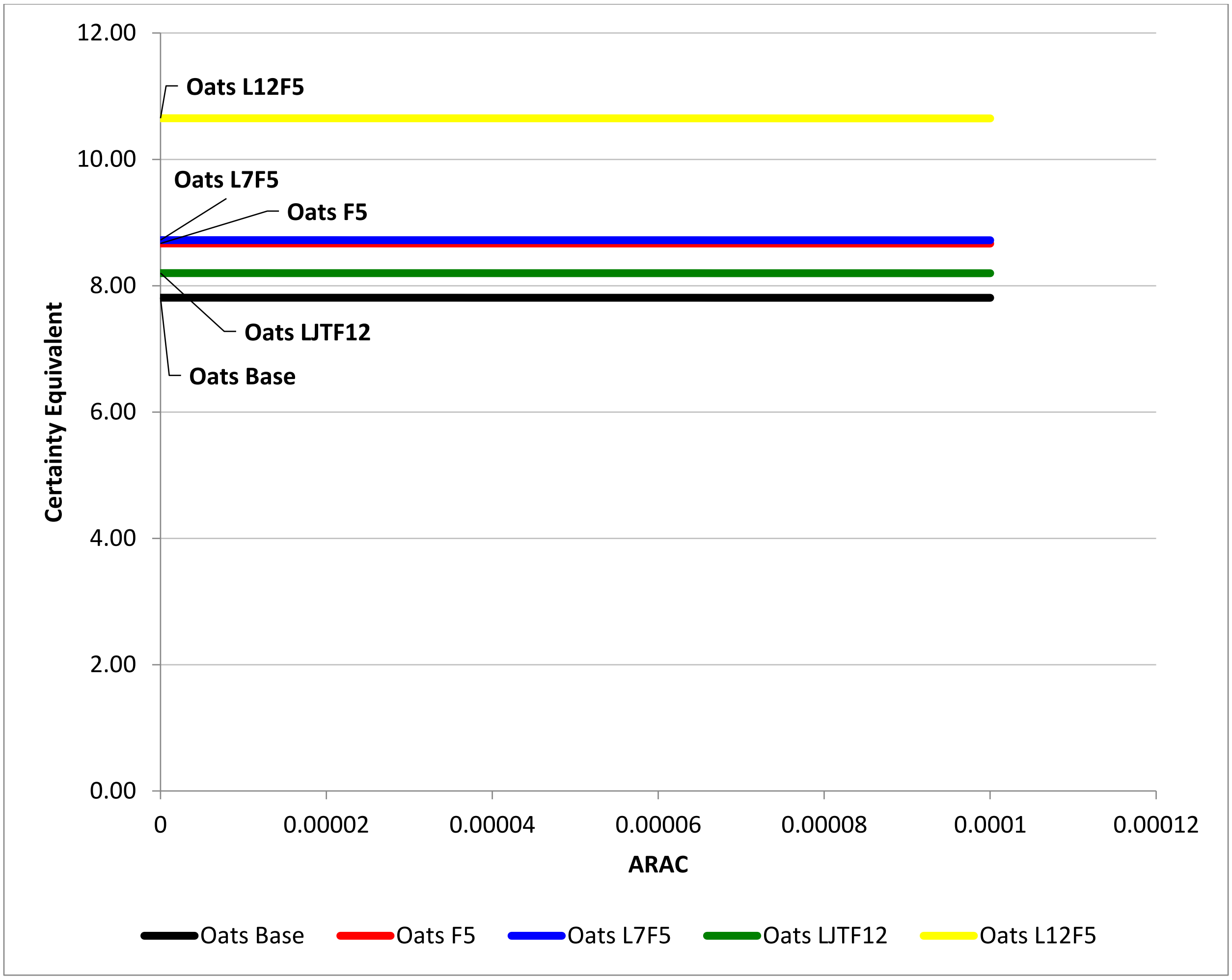

Figure B.9. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Oats.

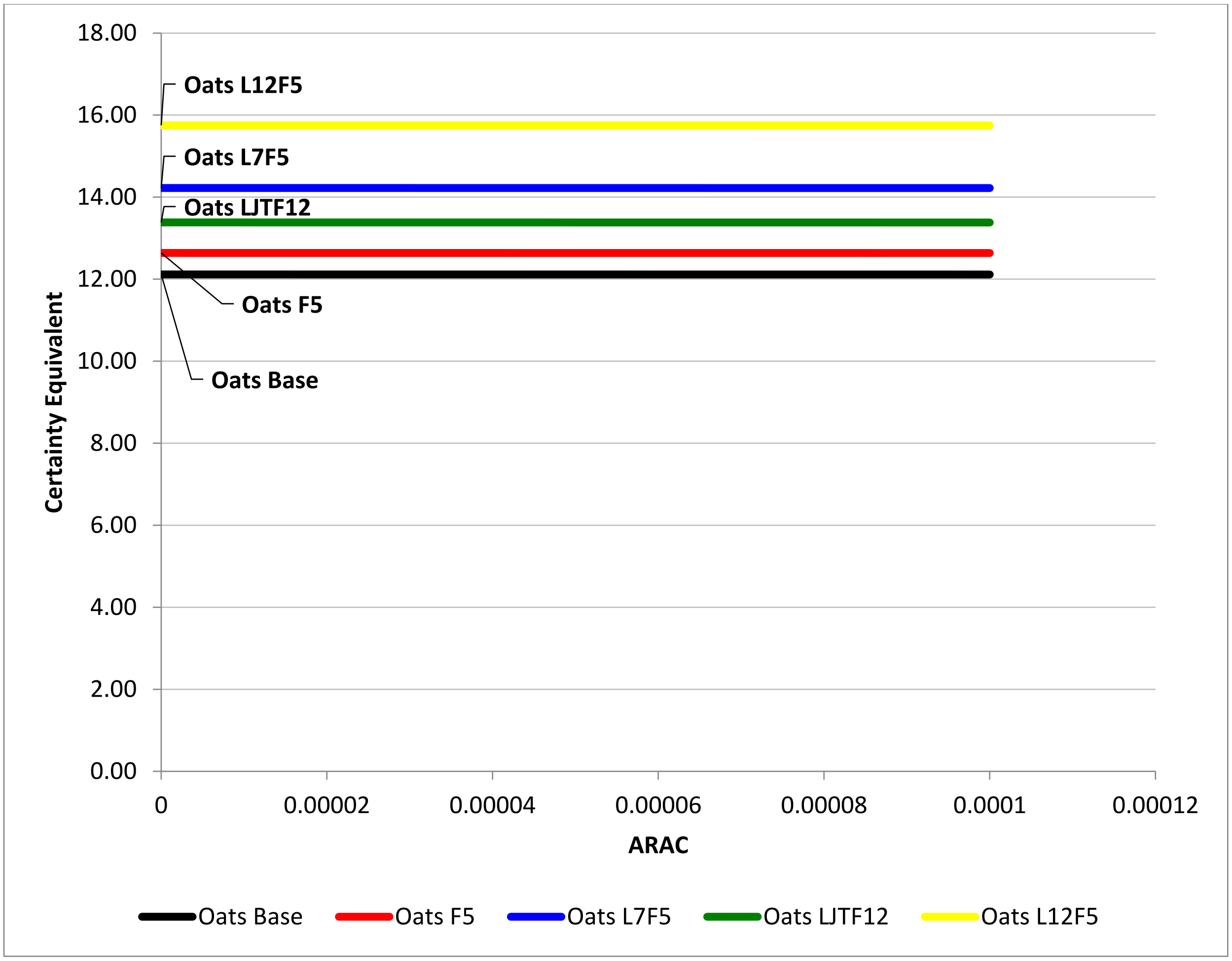

Figure B.10. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Oats.

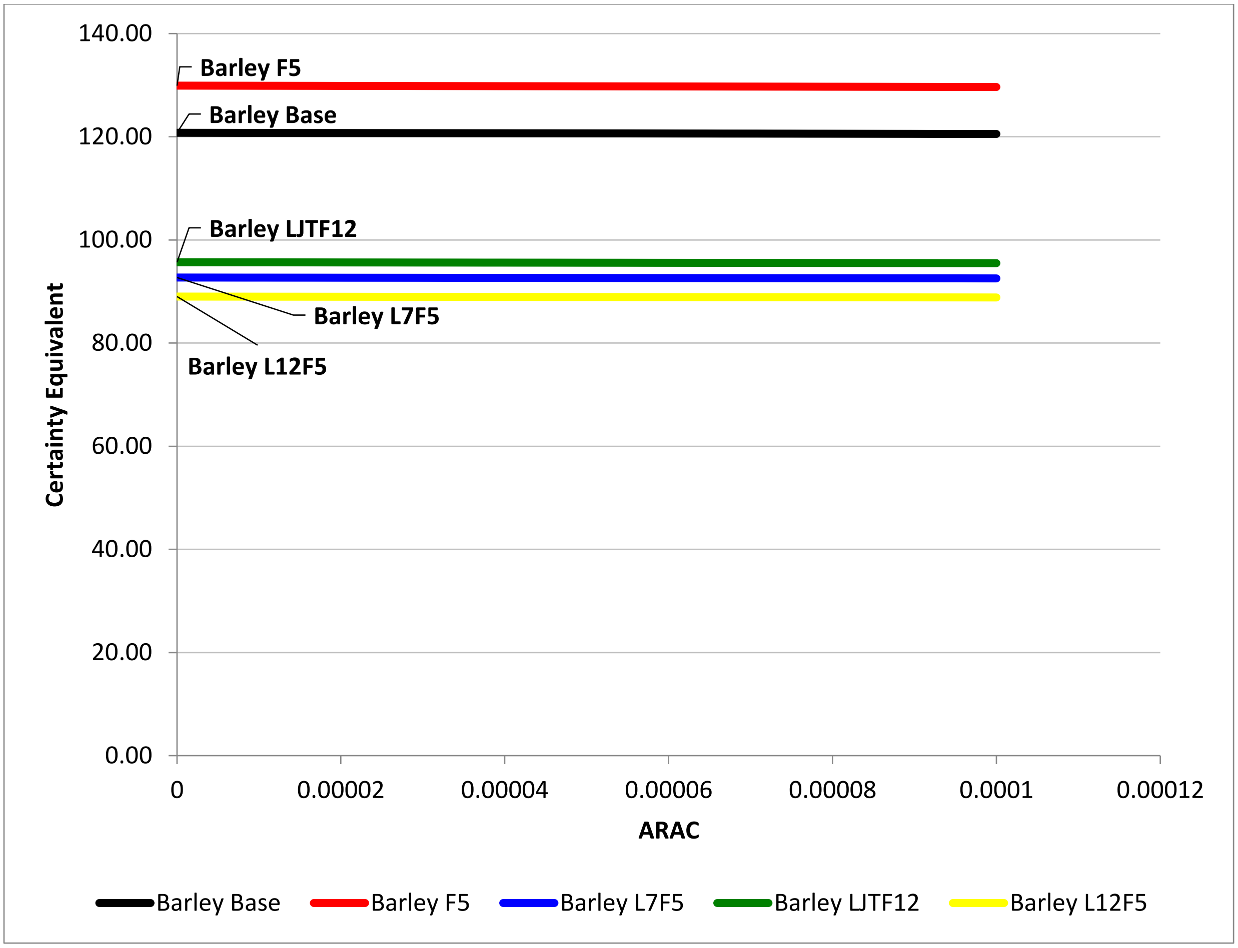

Figure B.11. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Barley.

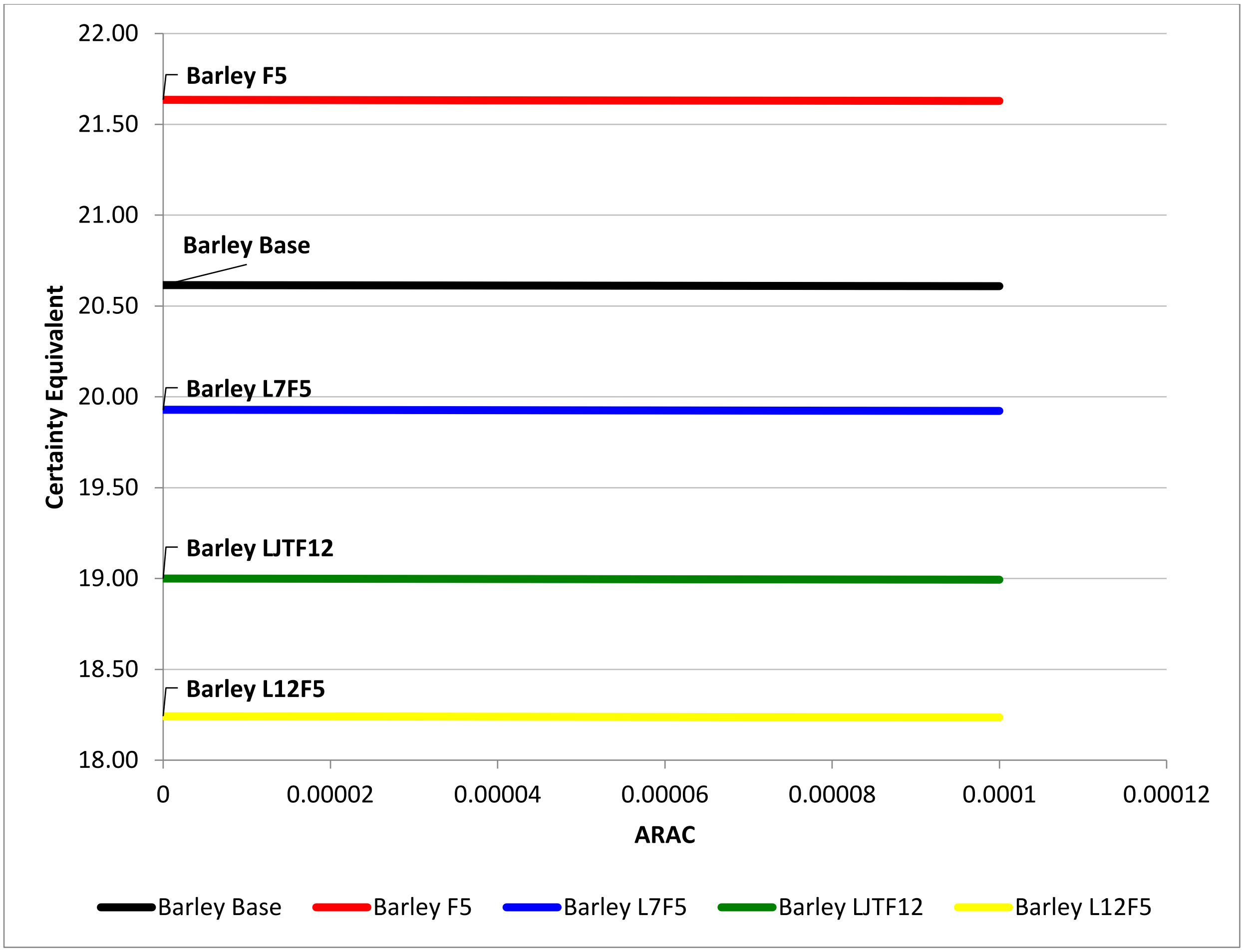

Figure B.12. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Barley.

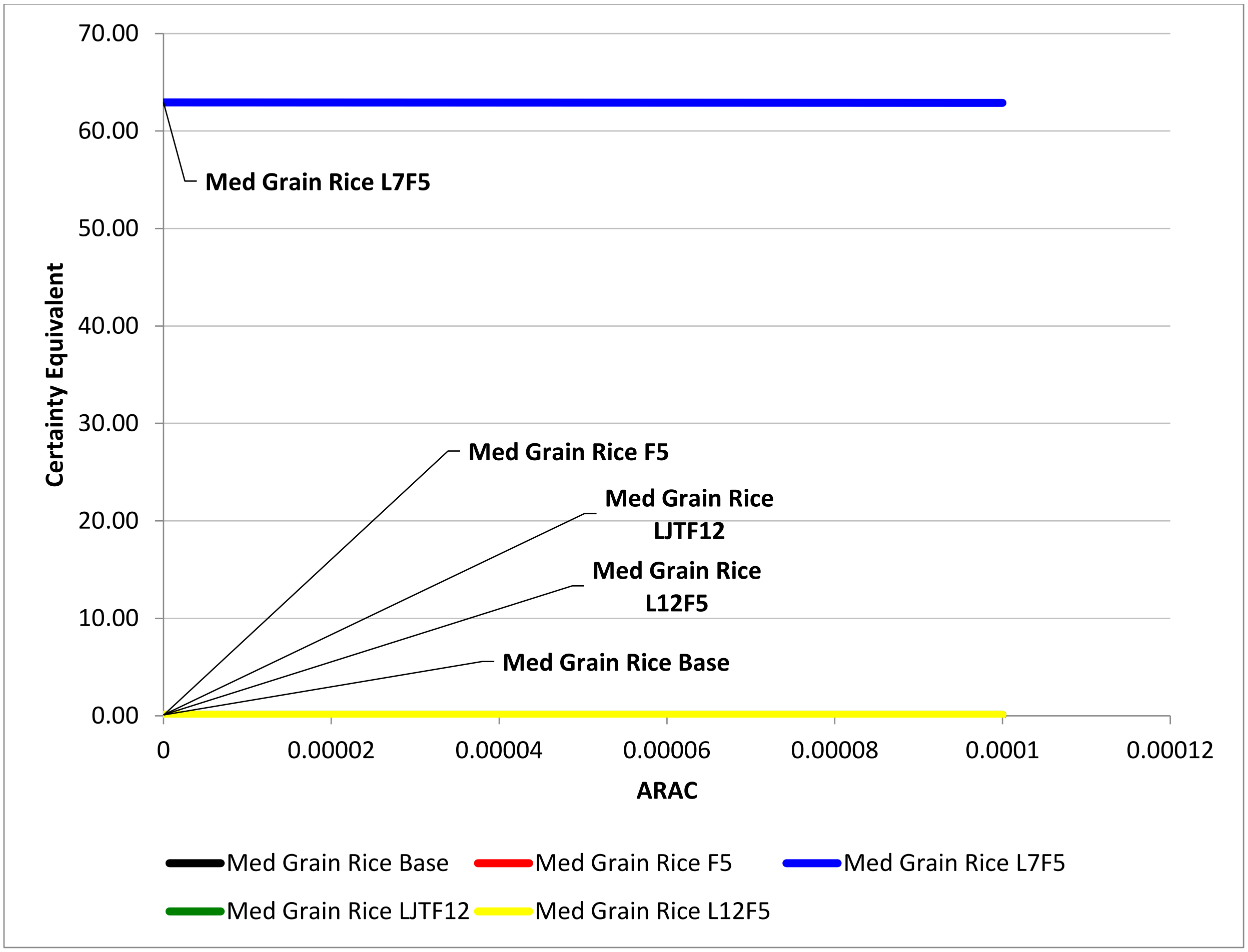

Figure B.13. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for MG Rice.

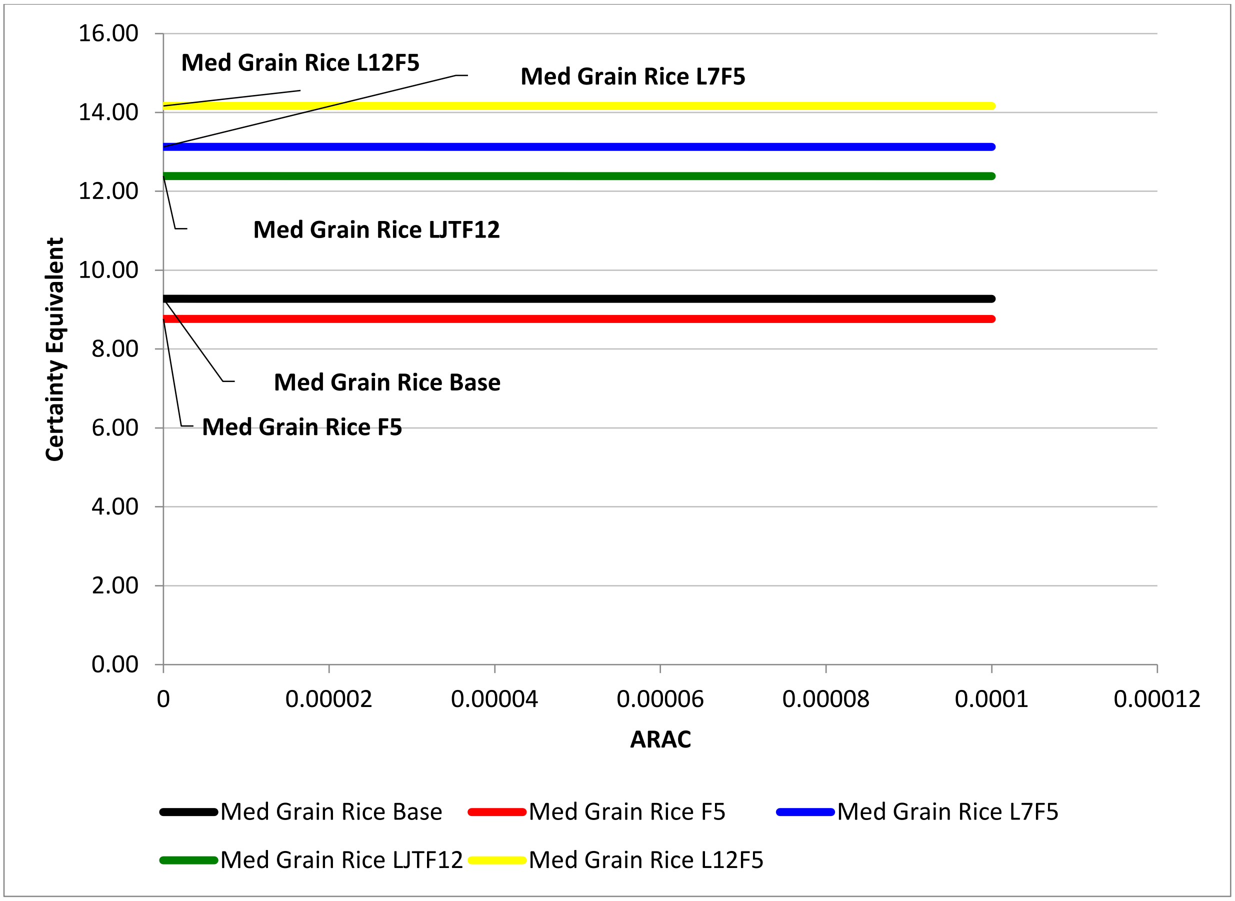

Figure B.14. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for MG Rice.

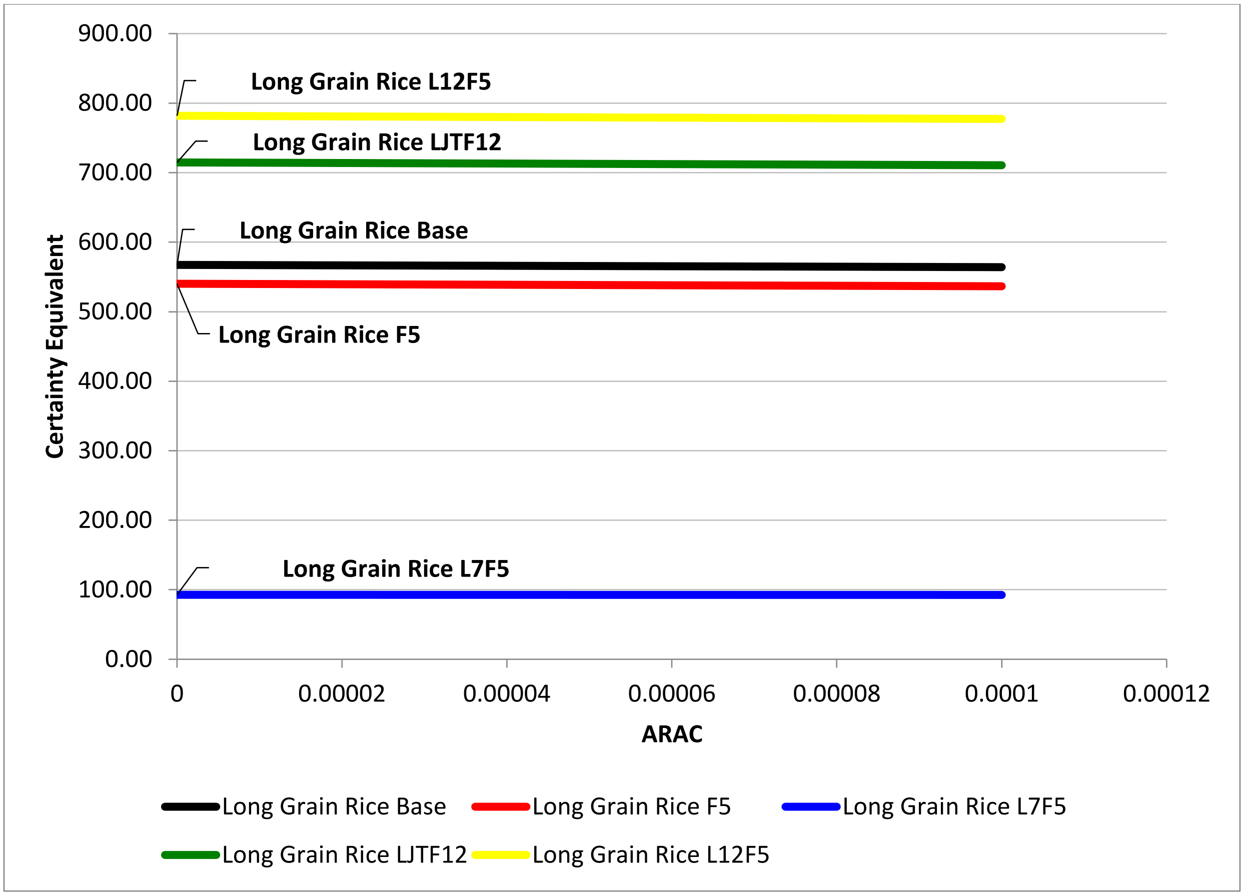

Figure B.15. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for LG Rice.

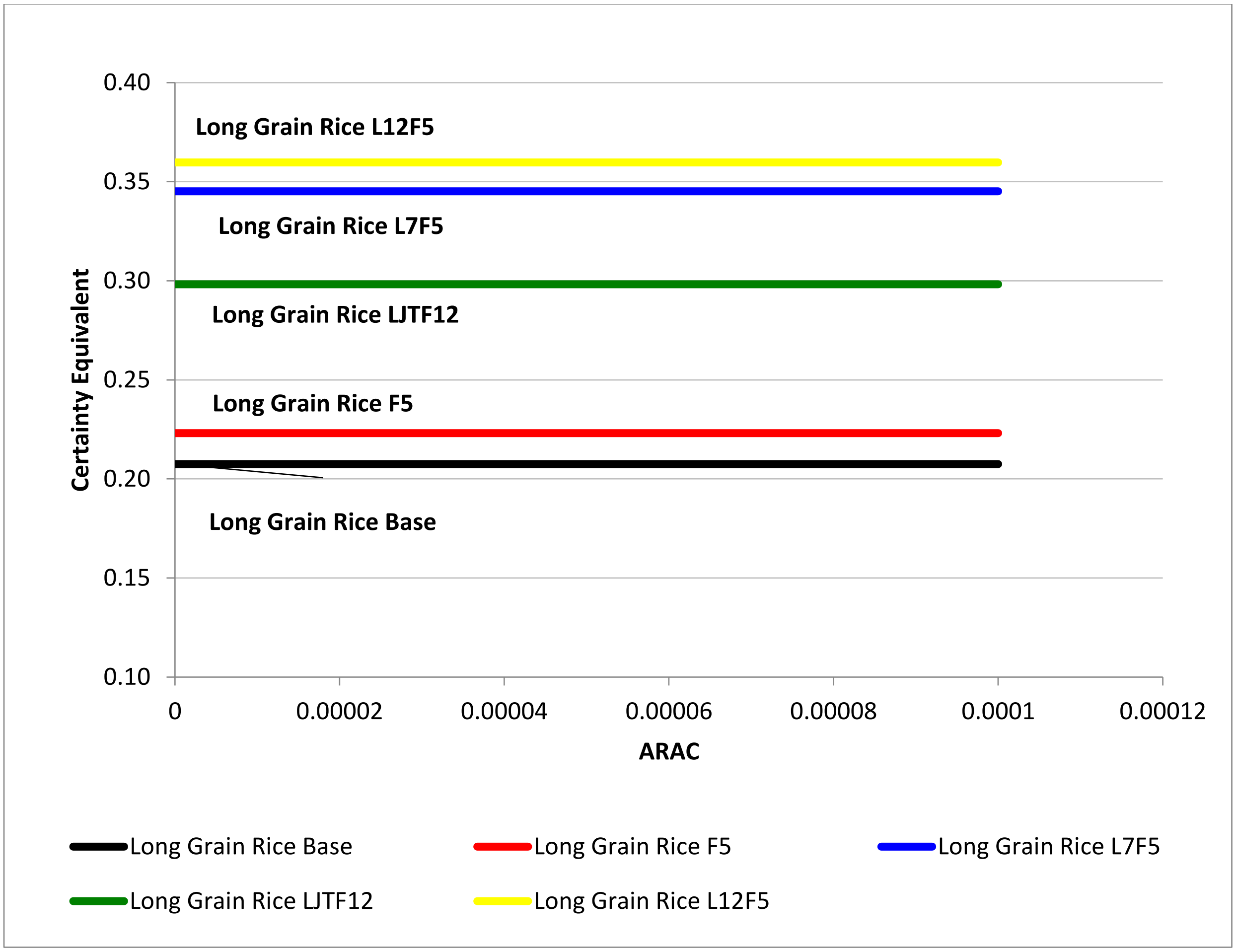

Figure B.16. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for LG Rice.

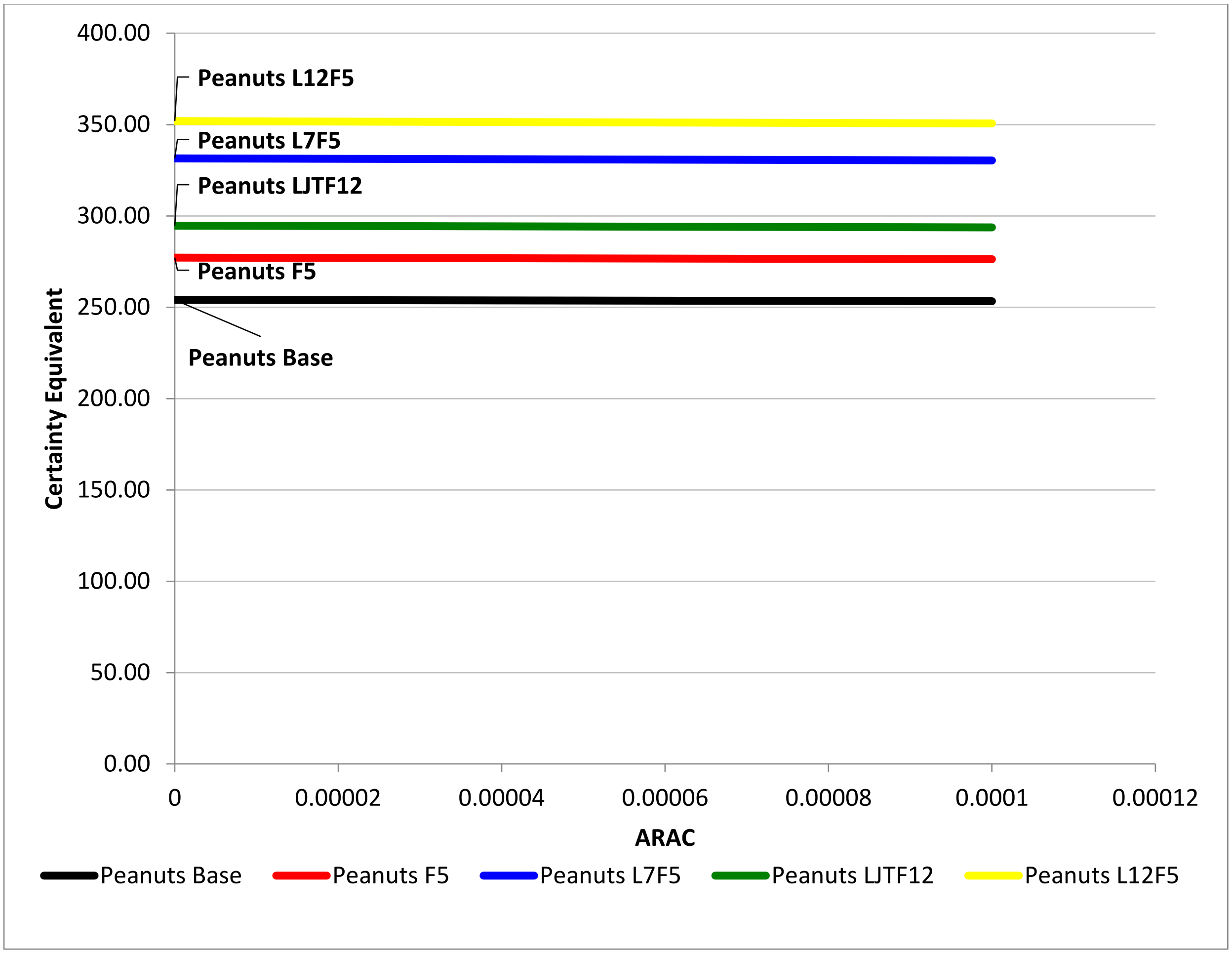

Figure B.17. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Peanuts.

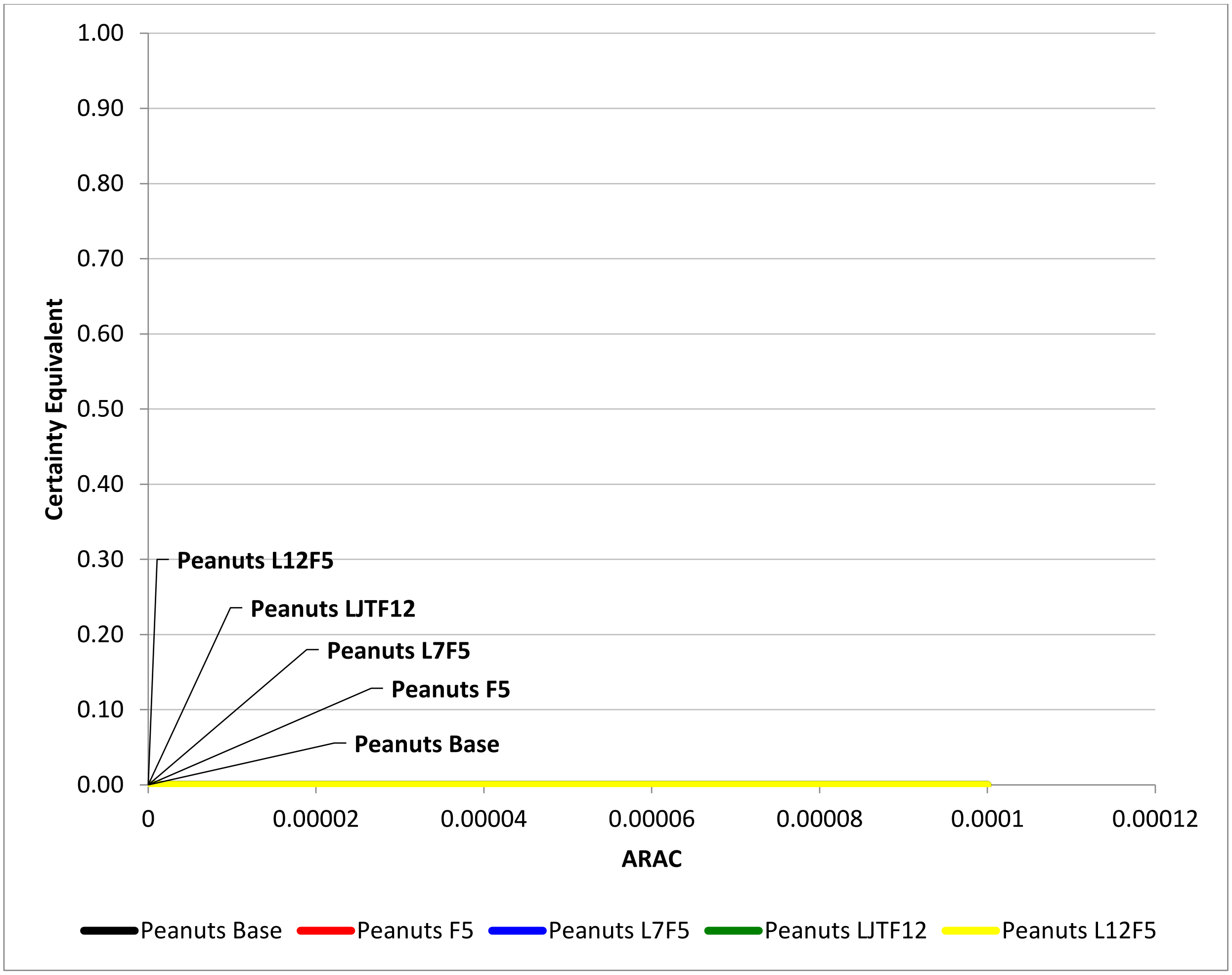

Figure B.18. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Peanuts.

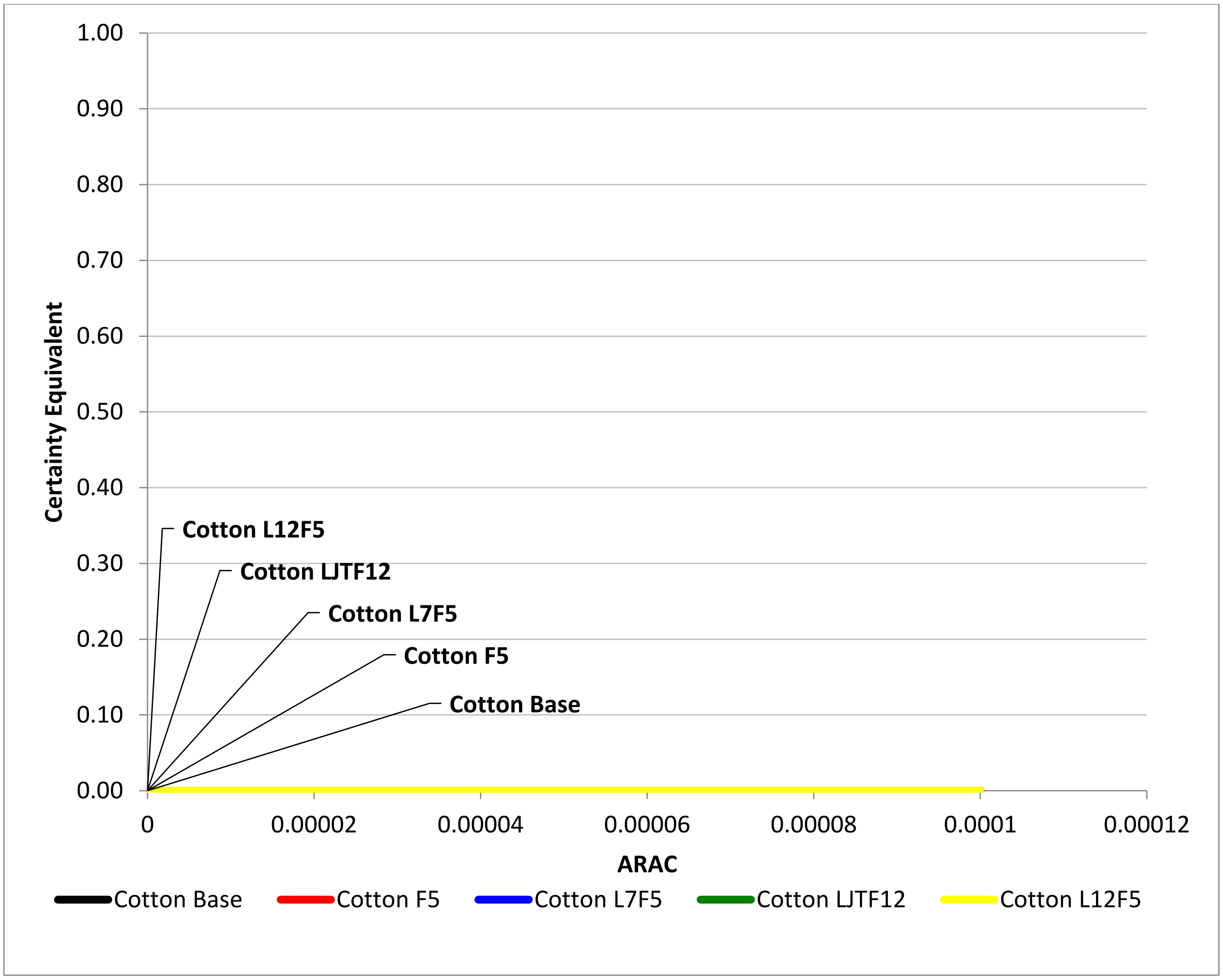

Figure B.19. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for PLC for Cotton.

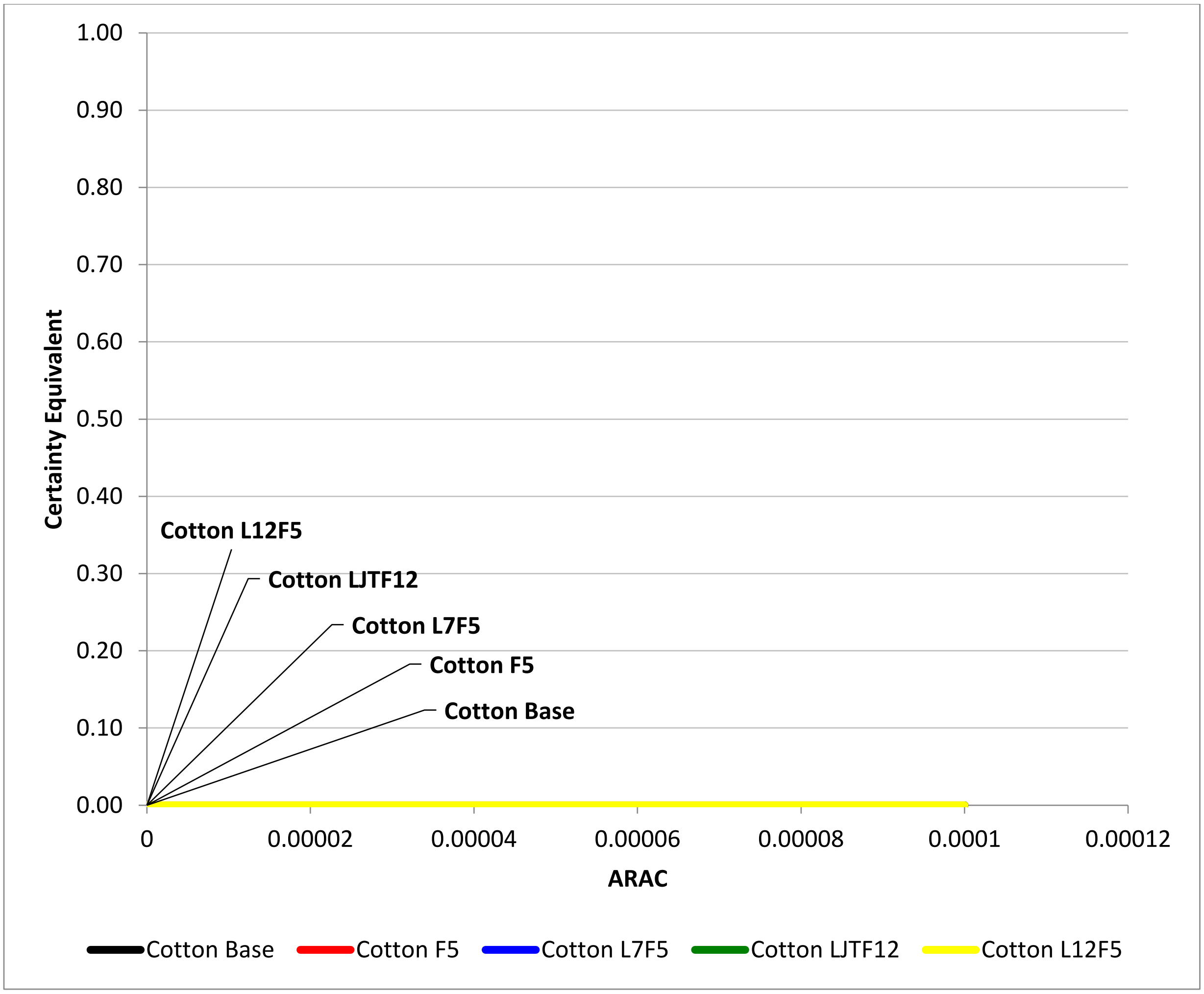

Figure B.20. Stochastic efficiency with respect to a function (SERF) under a negative exponential utility function for ARC for Cotton.